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Impact of Poultry Farming on Peak Expiratory Rate among Selected Farmers in Delta State South-South Nigeria

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Abstract

Background: The respiratory system supplies oxygen a crucial component of life, and disperses carbon dioxide a major waste product. Pulmonary parameter studied in the course of this study is Peak Expiratory Flow Rate (PEFR).

Objective: The study determined the effects of poultry farming on peak expiratory flow rate of farmers.

Methodology: A total of 247 poultry farmers and 247 control subjects were sourced from the three senatorial district of Delta State, Nigeria. Stratified random sampling technique was employed in the course of this study, and data gathered from the study were presented as Mean ± Standard Deviation. Student T-test, One-way analysis of variance (ANOVA), and Pearson Product moment correlation were used to analyze the data. SPSS 22 was the statistical software used and P-values <0.05 was considered as statistically significant.

Findings: Result of the study shows that increase exposure to poultry farming significantly decrease PEFR of both male and female subjects. This decrease was more severe in female subjects. Similarly, PEFR of poultry farmers increased with increase in body mass index (BMI). The PEFR significantly decreased in female subjects at normal and overweight BMIs when compared to the male subjects. The mean PEFR of the male subjects exposed to poultry farming was greater than that of the female subjects.

Conclusion: The Peak Expiratory Flow Rate decreases with increasing age and duration of exposure to poultry farming, and it was more severe in female subjects.

Keywords: Poultry farming • Peak Expiratory Flow rate• Farmers • South-south Nigeria

Introduction

The respiratory system supplies a critical component of life; the oxygen, and disposes a major waste product, carbon dioxide [1]. An occupational disease is any ailment that occurs as a result of work or occupational activity caused by exposure to disease-causing agents in the environment. Occupational respiratory disease includes occupational asthma, chronic obstructive pulmonary disease (COPD), silicosis, mesothelioma, asbestosis etc. Respiratory disease is a major occupational health risk for those working in agriculture, especially pig and poultry farmers are at increased risk of occupational respiratory diseases [2]. Research suggests that poultry farmers are occupationally exposed to many respiratory hazards (organic dusts) at work and display higher rates of asthmatic and respiratory symptoms than other workers (cow or swine) [3].

Being one of the risk risk factors in poultry production, and results from poultry residues, moulds and feather [4], poultry dusts may increase the risk of adverse respiratory disease occurrence in exposed poultry workers. This is because it is biologically an active constituent of microorganisms. This exposure may produce immune response against pathogenic biological agents. The response can be acute, recurrent or chronic in the lungs, depending on the frequency and level of exposure [5]. Exposure to poultry dust is known to produce variety of clinical responses, including asthma, chronic bronchitis, chronic airways obstructive disease (COPD), allergic alveolitis, and organic dust toxic syndrome (ODTS).

In recent times, work-related respiratory diseases are almost certainly an important cause of work-related morbidity and probably mortality in the world [6]. However, current data sources related to these diseases do not provide reliable or complete national data on the occurrence of these diseases. To this point, having a clear understanding of peak flow rate to occupational exposures to hazardous environmental elements may help target prevention activities.

Materials and Methods

Study design

A total of 15 poultry farms from three Senatorial Districts of Delta State, Nigeria were used. Based on their working experience (duration of being a poultry worker), subjects were grouped into four [4] groups; Group D (control subjects), Group B (those working for 1 to 10 years), Group C (those working for 11 to 20 years), and Group D (Those working for greater than 20 years), and the PEFR was taken with the aid of a peak flow meter.

Study population

The Population for this study is a selected numbers of poultry workers in the 3 senatorial districts (Delta Central, Delta North, and Delta South) of Delta State, Nigeria. The study consists of four hundred and ninety four (494) subjects; comprising 247 poultry workers and 247 control subjects.

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Samples and sampling technique

Using the stratified random sampling technique, a total of two hundred and forty seven (247) participants (poultry workers), were drawn from the above population and (247) control (subjects not exposed to poultry farms). While Ethiope East, Sapele local government area, Udu local government area, Ughelli North, and Uvwie local government area were sampled in Delta Central Senatorial District. Oshimili North, Aniocha North, Ika North East, Oshimili South, and Ika South were sampled in Delta North Senatorial Districts. Bomadi, Patani, Isoko South, Warri North, and Warri South local government area were sampled in Delta South. The sample size represents the number of poultry workers in the aforementioned local government areas of Delta State.

Selection criteria

Exclusion criteria

- Poultry farmers under any form of medication, age less than 15
- Asthmatic patients
- Smokers
- Pregnant women
- Workers less than one year of working experience
- Subjects with other underlying cardiovascular diseases and
- Those with related occupational history like those with history of working in sawmill or spraying industry

Inclusion criteria

- Ages 15-60 years
- Non-smokers
- Apparently healthy subjects without any cardiopulmonary diseases
- Those who worked for two years and above in the poultry industry

Measurement procedures

Peak Expiratory Flow Rate (PEFR): Peak Expiratory Flow Meter was used to measure the PEFR of subjects. The mouthpiece was connected to the peak flow meter and the meter set to zero. The subject was allowed to stand or sit upright while taking a deep breath. The subject was asked to breathe out as hard and as fast as possible after which the reading is taken. The process is repeated for 3 times and the highest reading is taken.

Body Mass Index (BMI): The weights (kg) of the subjects were measured with a bathroom scale and the heights (m) of the subjects were measured using a stadiometer. Body mass index (BMI) was calculated with the formula below:

BMI=Weight (kg)/ height $(m)^2$

Ethical considerations: Ethical consent was obtained from the Research and Ethics Committee of the College of Health Sciences, Delta State University, Abraka, Delta State. (Reg. number REC/FBMS/DELSU/18/101)

Analytical approach: Data were represented as Mean ± Standard Deviation. Student's T-test, One-way Analysis of variance (ANOVA), and Pearson's Product Moment Correlation were used to analyze the data. SPSS 22 was the software used for this analysis, and P-values ≤ 0.05 was considered statistically significant.

Results

Effect of poultry farming on peak expiratory flow rate of male subjects

In this study, the Peak Expiratory Flow Rate (PEFR) of poultry farmers was examined. It was observed that the PEFR of the male subjects increased following 1-10 years of poultry farming, when compared to PEFR of control subjects, but the increase was not significant. It was also observed that the PEFR of subjects who engaged in poultry farming for greater than 10 years was significantly reduced ($p<0.05$) when compared to the PEFR of control subjects and subjects that were into poultry farming for 1 - 10 years (Figure 1).

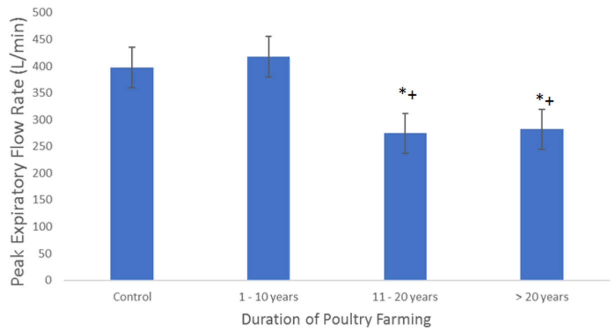

Figure 1. Peak expiratory flow rate of male subjects due to the effect of poultry farming. **Note:** *: $p<0.05$ when compared to control, +: $p<0.05$ when compared to 1-10 years.

Effect of poultry farming on peak expiratory flow rate of female subjects

Figure 2 shows the changes in Peak Expiratory Flow Rate of female poultry farmers. Data show that the PEFR of the female subjects decreased as the duration of poultry farming increased. This decrease in PEFR of female subjects was significant ($p<0.05$) when compared to the PEFR of control subjects. Statistical significant ($p<0.05$) decrease in PEFR of female subjects into poultry farming for 11- 20 years were observed when compared to the PEFR of female subjects into poultry farming for 1-10 years. The mean PEFR for 11-20 years and greater than 20 years duration of exposure were not significantly different (Figure 2).

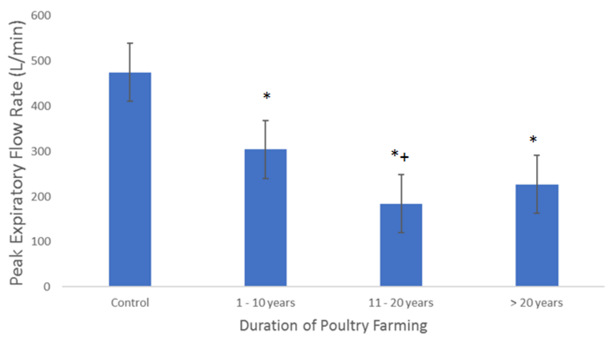

Figure 2. Peak expiratory flow rate of female subjects due to the effect of poultry farming. **Note***: $p<0.05$ when compared to Normal, +: $p<0.05$ when compared to 1-10.

Comparison between the peak expiratory flow rate in male and female poultry farmers

The Peak Expiratory Flow Rate (PEFR) of the male subjects who were exposed to poultry farming were significantly ($p<0.05$) greater than those of female subjects. This is irrespective of duration of exposure to poultry farming (Figure 3).

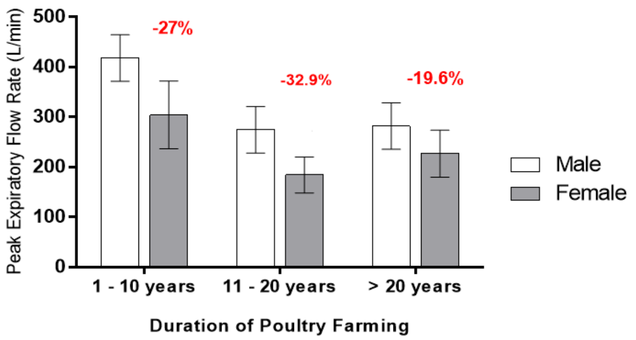

Figure 3. Poultry dust impact on peak expiratory flow rate. **Note***: Significantly less than the corresponding male value ($p<0.05$).

Relationship between duration of poultry farming and peak expiratory flow rate

In this experiment, the relationship between duration of poultry farming and peak expiratory flow rate was investigated. Data show that peak expiratory flow rate was inversely and significantly ($p<0.05$) correlated with duration of poultry farming (Figure 4).

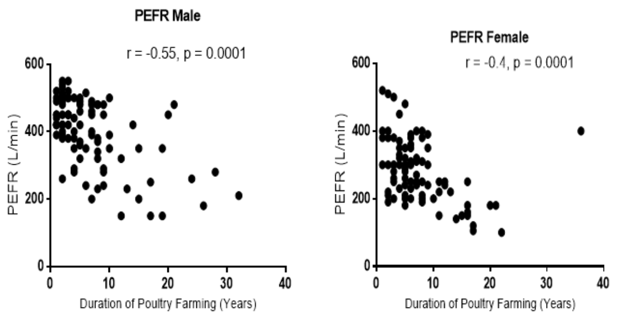

Figure 4. Association between duration of poultry farming and changes in peak expiratory flow rate.

Age and gender variation on peak expiratory flow rate of poultry farmers

In this aspect of the study, the effect of age on PEFR of male and female subjects exposed to poultry farming for 1-10 years was determined. The data show that the PEFR of the subjects exposed to poultry farming for 1-10 years was higher in female subjects when compared to male subjects of corresponding age range. It was also observed that the PEFR of the poultry farmers decreased with increase in age especially in subjects over 40 years of age. The effects of age on PEFR poultry farmers was observed to be greater in male subjects, as it was observed that the PEFR was significantly greater ($p<0.05$) in the female subjects (Figure 5).

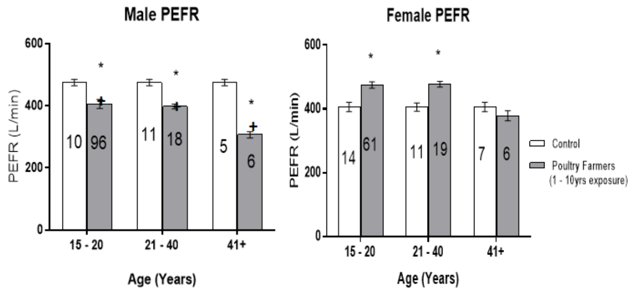

Figure 5. Changes in peak expiratory flow rate of poultry farmers due to the effect of age (n=247). **Note***: $p<0.05$ when compared to control PEFR, +: $p<0.05$ compared with corresponding female values.

Impact of Body Mass Index (BMI) on Peak Expiratory Flow Rate

Figure 6 show the impact of body mass index on peak expiratory flow rate of Poultry farmers. It was recorded that the peak expiratory flow rate (PEFR) in the poultry farmers increased with increase in body mass index, though no significance was observed. The PEFR decreased in the female subjects when compared to the male, with significant ($p<0.05$) decrease recorded in normal and overweight body mass index of female subjects. In all the BMI levels studied (underweight, normal and overweight), the mean PEFR of the male subjects exposed to poultry farming was greater than that of the female subjects (Figure 6).

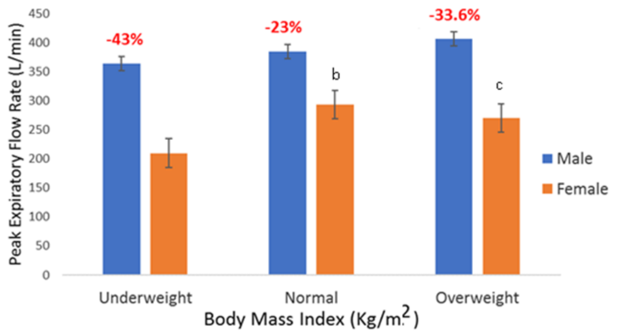

Figure 6. Impact of BMI on peak expiratory flow rate. **Note:** b: $p<0.05$ when compared to normal BMI male, c: $p<0.05$ when compared to overweight BMI male.

Discussion

Due to exposure to poultry dust in their work-place, poultry farmers have a higher morbidity and respiratory disease mortality than expected, and although this has been known for centuries [7] it remains a serious problem. It is well established that farmers may suffer from a number of different work-related diseases of the cardiovascular and respiratory organs [8]. Respiratory diseases are major factor in occupational disabilities with immune mechanisms probably playing an important role in many of these disorders.

Peak expiratory flow rate (PEFR) is the largest expiratory flow rate achieved with a maximally forced effort from a position of maximal inspiration. The PEFR is one of the convenient methods of measuring lung functions [9]. Result from this study show that there is age dependent decrease ($p<0.05$) in PEFR of male and female subjects exposed to poultry farming. The PEFR decreased with increase in age of the subjects. Similar findings were observed by previous studies [10] though not related to poultry farming. The observed decrease in the PEFR will suggest that the decrease in PEFR with increase in age may be due to degenerative changes in the lung function with increase in age. The decrease in PEFR among the poultry farmers was more severe in male subjects compared to female subjects, suggesting possible gender variation which has further strengthened earlier report by Ovuakporaye et al. [11]. The differential severity in the males and females may however be related to the variable pattern of fat distribution in the respective farmers. The pattern of fat deposition in females is more in the extremities (peripheral obesity), whereas in males fat deposit is seen more in the truncal region (central obesity) [12,13].

Previous reports had indicated a rather strong positive correlation between BMI and PEFR. Ulger et al. [14] and Hakala et al. [15] had previously reported a significant positive correlation between BMI and PEFR in obese children and patients with asthma respectively. Our findings are in agreement with the aforementioned report, as increase in BMI increased the PEFR of the subjects. Contrasting observations were however made by Bhardwaj et al. [10], and Saxena et al. [16], suggesting that obesity itself and especially the pattern of body fat distribution may have independent effects on PEFR. You-Chen et al. [17] showed that abdominal fat is negatively and consistently associated with pulmonary function. Mungreify et al. [18] found PEFR to be maximum among subjects with normal BMI, followed by overweight and obesity. Both low and high BMI were associated with poor lung functions which results in combination of airway narrowing and decreased lung recoil [19].

The annual removal and weekly turnover of the "bed" normally result in intense exposure to dusts and micro-organisms such as bacteria, fungi, viruses and endotoxins [20]. Results from the present study corroborate previous studies that documented the respiratory risk of raising animals in confined spaces [21] and, more specifically, the respiratory risks of poultry confinement [22]. Malmberg and Rask-Andersen [23] reported that inhalation of organic dust may cause an acute inflammatory reaction in the airways and fever in non-sensitized subjects, which is called toxic pneumonities or organic dust syndrome. In addition, a person exposed to a high level of dust may experience increased phlegm production and pulmonary inflammation 4 to 10 hours after exposure that can last up to 24 hours, conversely chronic exposure may result in bronchitis and asthma [24]. These assertions from the above studies are confirmed by the data generated in this study: as the PEFR was significantly decreased with increase in duration of exposure to poultry farming. In fact, there was an inverse and significant correlation between the duration of exposure to poultry farming and PEFR of male and female subjects. Radon et al. [20] showed that poultry workers are exposed to higher concentrations of dust and have lower mean lung functions.

Similar observation was also reported on swine and poultry workers by Burch et al., [25], Kogevinas et al., [26] Rimac et al., [2] and among veterinary surgeons [27]. In fact, individuals involved in animal production, especially pig and poultry farmers, display a higher prevalence of adverse respiratory symptoms than other farmers and other rural residents [2]. Also, Lutsky and Neuman [28] showed that workers who are regularly exposed to poultry had impaired pulmonary function more often than workers with intermittent exposure," and a deleterious effect of poultry house dust was suggested as the cause. Farmers generally are exposed occupationally too many respiratory hazards and they have high rate of asthma, inflammatory manifestations, and respiratory symptoms [29].

Increase in duration of poultry farming activities will obviously increase the poultry farmers' chances of exposure to poultry dust. The dust originates from poultry residues, molds, and feathers, and is biologically active as it contains microorganisms, some of which may be pathogens. Dust acts as a host for biological fragments that may serve as a sensitizer [30]. Alencar et al. [5] claimed that poultry dust produce immune responses against pathogenic biological agents. The response may be acute, recurrent, or chronic in the lungs, depending mainly on the frequency and level of exposure. Several inflammatory agents are also present; among them is bacterial endotoxin, which was found to be related to the presence of decrease in respiratory airflow and subjective symptoms [31].

In the present study, the female poultry farmers were found to be more susceptible to adverse effect of long duration of poultry farming on PEFR. It was observed that the mean PEFR of the female subjects was lower than that of the male subjects, for each duration of exposure studied. This differential impact of duration of exposure to poultry farming on lung function is related to gender variation of the subject.

Conclusion

The findings from this study have established that exposure to poultry farming decreases Peak Expiratory Flow Rate with consequent decline in lung function. The decrease in PEFR caused by exposure to poultry farming was more severe in female subjects. It was also observed that this comes with increasing age.

Acknowledgement

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Conflict of Interest

There is no conflict of interest.

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