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Production methods in animal farming have changed dramatically over the past 20 years. An emphasis on cheaper, more efficient ways of production has provided the impetus for larger, more concentrated systems. Improvements in building construction, heating and ventilation have been developed that provide the opportunity to increase the number of animals that can be raised in confinement. Improvements in animal health have reduced the risk of loss from disease.

Confinement of large numbers of animals can have adverse effects on the environment and upon the health of employees exposed to such environments. As the trend toward large scale animal production continues, more workers will be employed full-time in this occupation, which increases the risk for disease and injury. The environment within livestock and poultry buildings contains many different respiratory hazards for the worker. These include gaseous contaminants such as ammonia and hydrogen sulfide, and particulate contaminants (dust), including animal dander, dried feces, endotoxin, molds and fungi.

The Occupational Safety and Health Administration has issued exposure limits for particulate dusts but no exposure limits have been issued that take into consideration the combined effect that these contaminants have on the respiratory health of the confinement worker. Studies have been conducted that indicate a decline in pulmonary function and increased complaints of cough, phlegm, asthma-like illnesses and acute respiratory disease in these workers. The purpose of this paper is to review past studies to determine the significance of the association of confinement work and respiratory disease.

Literature Review

A cohort study conducted by Baser, et al, was conducted to investigate the respiratory effects of chronic animal feed dust exposure. This study was undertaken in Turkey in a factory that has the highest grain production in the Middle East. The study group was composed of animal food processing workers; all were volunteers. A group of hospital workers in that city were used for a control group. Respiratory questionnaires were completed along with a smoking history. The subjects were stratified into groups according to the history. Sample size consisted of 108 feed industry workers and a cohort group of 108 unexposed hospital workers and were of similar age, sex, social and economic status and similar smoking history. Consideration was given to matching control subjects to the exposed group in order to have accurate comparison. All subjects were volunteers; volunteers for studies may be more motivated and may be more conscious of health and safety issues than non-participants. The working conditions of the control group were not noted, and hospital workers may be of the same economic status as the exposed group and have considerable respiratory exposure also. Hospitals in Turkey may not be the same as we enjoy here in the United States.

Assessment of work related respiratory symptoms were determined by performing pulmonary function tests on animal feed workers per standard protocols. Total and respirable dusts were collected over an eight-hour work shift and concentrations were determined with gravimetric sampling.

When statistical analysis was performed, the work group was found to have significantly higher prevalence of respiratory symptoms than the control group. There was no significant difference in reporting work related respiratory symptoms between the workers who had worked more than 10 years and those who worked less than 10 years. Cessation of symptoms was reported by most during breaks and holidays. Several tables were used to present information in a format that was easily understood.

An analysis of the pulmonary function tests showed that exposure was the cause of a decline in pulmonary function. Gravimetric samples show respirable dusts concentrations varied from .39 mg/m3 to 2.8 mg/m3. Animal feed dust exposure in an occupational setting can affect respiratory health of the worker; this was found to be independent of smoking status in this study. This study accomplished the stated purpose and results indicate significant impact of dust on the respiratory health of the worker.

Donham, et al, conducted research in 2000 investigating the respiratory effects on employees of poultry confinement facilities. This study was done to examine dose-response relationship of bioaerosols exposures and respiratory health. While guidelines indicating safe exposures are not available, and no current limits have been issued by any governing agency, previous studies in swine confinement have resulted in recommended limits of 2.5 mg.m3 total dust, 0.23 mg/m3 respirable dust, 100EU/m3 endotoxin and 7 ppm for ammonia.

Study population included 257 poultry producers in Iowa. A non-exposed blue-collar worker group was used for comparison. Pulmonary function tests were performed before and after the work period. Personal sampling was conducted for total and respirable dust, total and respirable endotoxin and ammonia. Analysis showed poultry work as significantly associated with cross-shift decline in FEV1 and FEF. Total dust ranged from 001 to 7.73 mg/m3, total endotoxin 0.24 to 167 EU/m3, respirable endotoxin .035 to 694 EU/m3 and ammonia 0 to 75 ppm.

A later study published in 2002 by Donham, Cumro, and Reynolds, builds on the study reviewed above and discusses health effects of the combination of bioaerosols, organic dusts and gases on the respiratory health of the workers. A cohort study of 257 poultry production workers and a control group of 150 non-exposed blue-collar workers from the postal service and an area electronic plant was used. Health interviews and medical evaluations were performed. Pulmonary function tests were done pre and post work shift. Environmental samples consisted of total dust, respirable dust, total endotoxin, respirable endotoxin and ammonia.

Determining specific threshold measures and dose-response reactions were goals of this study. Methods included medical evaluation and pulmonary function testing for both exposed and non-exposed groups. These evaluations were performed by trained interviewers and technicians to assure continuity in testing. It is not mentioned in the study if the control group was questioned for hobbies or additional occupations such as farming that might confound the study. Also, poultry and egg producers who volunteer to participate may have a bias in reporting symptoms.

Results were controlled for age, years worked, gender and smoking status. Interpretation shows an increased risk with combined effects of dust and ammonia exposure. The synergistic effects were found to be responsible for increased cross shift declines in pulmonary function.

Poultry workers had more respiratory symptoms and significantly larger cross shift declines in forced expiratory lung volumes. Ammonia adsorbs to the dust particles and when it enters the lower respiratory tract causes direct irritation. The authors state that the interaction of dusts and ammonia run counter to the current American Conference of Governmental Industrial Hygiene methods that suggest a second substance cannot reach above half its threshold limit value. From an occupational health standpoint, one or both of these substances need to be reduced simultaneously. This study validates previous studies that recommend much lower exposure limits than current Occupational Safety and Health Administration values.

Industrial facilities including grain mills, farms and barns contain high numbers of airborne fungi. There are reports of adverse health effects on workers exposed to these microorganisms. Some of these adverse health effects include; organic dust toxic syndrome, mycotoxicosis and allergic alveolitis.

A pilot investigation by Lugauskas, et al, on airborne fungi in some of the industrial environments in Lithuania was conducted. Six industrial facilities were chosen for the investigation on airborne fungi. These included: a poultry house, a swinery, a feed preparing and storing house at the swinery, a grain mill, factory for wooden panel production and an organic waste recycling facility. In collecting samples from industrial and/or agricultural sites it is important to note what processes were occurring when the samples were collected. This may have significant impact on types and amounts obtained.

Four techniques were used for trapping airborne fungi: sir filtering, solid plate impaction, liquid impingement and sedimentation. Values obtained by the settle plate method were not included in the results. The impactor proved to be the most efficient method of collecting viable fungal spores.

The highest concentrations of viable fungal spores were collected in the grain mill, with 49 species isolated. The remaining five facilities included discovery of 31 species in the poultry house, 33 in the swinery, 35 in the feed processing, and storing, 21 in the wood palate factory and 40 in the organic waste recycling facility. This study was fairly straight-forward in its implementation. Various methods of collecting airborne fungi were implemented in gathering data. Identification of fungi was presented in two large, readable tables.

These industrial sites were found to be heavily polluted by airborne fungi. The pollution of occupational environments by airborne fungi is a concern for the occupational health of the workers.

The purpose of a study by Radon, et al, was to describe the relationship between spirometric studies and exposure to organic dust. In Denmark, swine farmers have the highest respiratory health issues, and so forty pig farmers were selected randomly from this population. In Denmark, poultry farmers have the lowest incidence of respiratory disease so 36 poultry farmers in Switzerland were chosen randomly for the control group, and were assessed over one working day. This leads to the question of whether swine production in Denmark and poultry production in Switzerland are similar enough to make a good comparison for exposure. Are the buildings similar enough in construction and ventilation to provide proper data?

Questionnaires were completed by the selected subjects. The study indicates that identical health questionnaires were used but adapted for the specific type of animal production; again this may be a confounding problem for this study. These included types of animals, ventilation and heating in the units and report of respiratory symptoms. Lung function tests were performed prior to and after the work shift. Personal monitors were used to collect samples for each farmer during work. These were analyzed for total dust, endotoxin concentration and fungi. Ammonia, air temperature, humidity and air velocity were also measured.

Comparing the lung function studies, pig framers had significantly higher lung function than poultry farmers in all spirometric variables except FVC. Factors related to work in the housed areas of pigs and poultry (ventilation, etc.) were significantly associated with decreased lung function. Higher temperatures in the pig houses were significantly negatively associated with lung function in pig farmers. A low standard of ventilation control inside the animal houses was related to long term impairment of lung function, further study is recommended.

These findings are similar to other research studies that indicate poultry farmers may have a higher incidence of reparatory health issues than swine farmers. This study did address the normal decline in lung function, which should be mentioned in all lung function studies. Environmental issues such as heating and ventilation are of great importance in assessing work environment and this study did provide much information in this area.

Conclusion

The above studies clearly indicate a health issue that should be addressed by government and public health entities. All data points to the fact that the combination of respiratory hazards in confinement facilities must be taken into consideration when analyzing the safety of the work environment. Further research should focus on establishing safe exposure limits. As large-scale animal production increases in the United States, emphasis should be placed on the health of the confinement worker. Engineering and environmental control must be addressed and further studies could be conducted to determine optimum environmental states for the employee and the animals. The evidence in these studies provides ample information to proceed with recommendations for exposure limits and further environmental engineering.

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