



Topics in Respiratory Health of Farmworkers

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Introduction

Migrant and seasonal farmworkers are subject to a wide range of occupation-related illnesses and injuries from working in one of the country's most dangerous industries [1]. One agricultural health issue that has received limited attention with respect to farmworkers is respiratory illnesses. A wide variety of toxic agents found in the agricultural setting can lead to respiratory problems, including pesticides and other agricultural chemicals, plant antigens, animal waste, dust, and a host of micro-organisms and other allergens and irritants [2-4]. To the extent that certain occupational exposures are manageable and/or avoidable, many respiratory diseases among farmworkers may be considered largely preventable [5].

Respiratory health issues are especially difficult to characterize because a given illness can have multiple etiologies, while a given exposure can have multiple health endpoints [6]. Overall, occupational exposures leading to respiratory disease take an enormous toll on worker health. The National Institute for Occupational Safety and Health (NIOSH) estimates that work-related respiratory disease and malignancies comprise about 70% of all occupationally-related deaths. Some of the work-related respiratory diseases being targeted by NIOSH for research and prevention include asthma, chronic obstructive pulmonary disease (COPD), silicosis and

asbestosis, respiratory infectious diseases including tuberculosis, avian severe acute respiratory syndrome (SARS), and respiratory cancers [7].

This paper reviews respiratory health issues and exposures relevant to migrant and seasonal farmworkers working in crop agriculture in the United States.¹ The discussion draws on a range of studies relevant to respiratory health in agricultural settings, including some addressing growers, workers in other countries, and health effects of para-occupational exposures to relevant agents, e.g., prenatal and take-home pesticide exposure, for the following reasons:

- To date, most population-based research on occupational health in agriculture has lumped migrant and seasonal farmworkers (MSFW) in with farmers and other full time agricultural employees [3;6;8]. The relative lack of research that singles out farmworkers makes it difficult to accurately characterize the frequency and prevalence of occupational health problems in this population [6]. However, many agricultural health risks are the same regardless of employment status, and farmworkers are likely to be exposed to them to a greater or lesser extent depending on activity and crop.
- Much of the research on respiratory issues in agriculture, particularly with respect to pesticide exposure, has been conducted outside the United States. While the circumstances of farmworkers in the US may not be directly comparable to those of workers in other countries, the findings of those studies still provide important information and direction for health care, education and policy to reduce occupational respiratory disease.
- In general, the importance of pesticides as an occupational health risk for farmworkers makes studies linking pesticide exposure to respiratory problems relevant regardless of the

¹ Laboratory research and respiratory health issues connected with livestock or animal feeding operations are not included in this review.

context of a given study. The agricultural setting, i.e., farm, is unique in occupational research because it is often both workplace and residence, making it difficult to distinguish occupational from residential exposure, especially in the case of non-farmworker family members, who are at risk for a variety of para-occupational exposures [2].

Respiratory Health in the Agricultural Setting

The crops, activities, and exposure agents that can lead to respiratory disease are extraordinarily diverse and vary significantly by seasons, geography and type of agriculture. The number of substances affecting respiratory health to which a worker is exposed while working in an agricultural setting is enormous: pesticides, including insecticides, herbicides, and fumigants; other agricultural chemicals, including fertilizers and plant growth regulators; the crops and related allergens, such as pollens, pests, and microorganisms; and the land itself, including organic and inorganic dusts, to name just a few [2;9]. Further complicating the issue, the likelihood that an individual worker has been exposed to but a single identifiable agent is small. Measuring exposure is also challenging, which makes dose-response relationships difficult to assess, and exposure limits have not been set for most relevant agents [2]. Agricultural respiratory disease often goes untreated and unreported, especially by small operations not regulated by the Occupational Safety and Health Administration (OSHA), making it nearly impossible to determine the true extent of the problem [10].

Nonetheless, analyses of national and regional databases on occupational health and injuries indicate that respiratory diseases are responsible for significant mortality and morbidity among individuals who work in agriculture, including farmworkers. Proportionate mortality rates due to respiratory diseases were significantly elevated with respect to all causes of death of farmworkers reported in 24 states between 1984 and 1993 [11]. Among deaths of farmworkers

due to respiratory diseases between 1988 and 1999, the mortality rate for hypersensitivity pneumonitis was 10 times higher than expected, and elevated for other respiratory causes such as asthma, bronchitis, histoplasmosis, pneumonia and influenza [12]. In terms of morbidity, within the general US population, individuals whose longest job was as a farmworker had elevated prevalence of phlegm production, and female farmworkers had elevated rates of wheeze. Also, farmworkers had an elevated prevalence ratio for obstructive abnormality of the lungs [12].

Only a small number of regional studies specifically focused on general respiratory health of farmworkers who work in crop agriculture have been conducted in the US. Migratory farmworkers in Indiana demonstrated higher levels of respiratory symptoms during the agricultural season than during their home-based months. Prevalence was higher among older workers than among adolescents, indicating the possibility of a cumulative affect over time in farmwork [13]. Simply working eight or more months per year in agriculture contributed at least as much to respiratory problems as did current smoking among Hispanic farmworkers in California [14].

Asthma is an important issue in agriculture because so many substances found on farms are known contributors to either occupational asthma or work-aggravated asthma [9]. Occupational asthma results from causes and conditions encountered only in an occupational environment; work-aggravated asthma refers to pre-existing asthma exacerbated by workplace exposures. Asthma due to occupational exposure is the leading diagnosis of respiratory disease in developed countries [15]. Pre-existing asthma is likely to be exacerbated by exposure to dust and other substances in the agricultural workplace [16]. Data from the National Health and Nutrition Examination Survey (NHANES) of work-related asthma and work-related wheezing indicate an increased risk of both in farm- and agriculture-related occupations [15]. A study of

asthma among elderly Hispanic and non-Hispanic whites in Texas found a significant positive association between current asthma and a history of having done farm-related work [17].

Despite the large number of obvious respiratory health threats to which farmworkers are exposed, relatively few have been studied in depth. Exposure to respirable silica dust, linked to silicosis, has been identified a respiratory hazard for farmworkers in North Carolina [18].

Exposure to dusts, soil, clay, and sand from cultivation activities has been associated with chronic respiratory symptoms in California, including cough, wheeze, bronchitis and asthma [19]. Clay soils can absorb organic dusts, including pesticides, that are released when the ground is worked [2]. Anhydrous ammonia (fertilizer) has been linked to long term lower respiratory tract injury [16]. However, the bulk of the research on respiratory hazards in farmworker has been conducted with pesticides, and will be covered in more depth in the next section.

Pesticides and Respiratory Disease

The various means of exposure to pesticides beyond working directly with them, e.g., residue and drift, create hazardous working conditions for all agricultural workers regardless of individual activity [20]. Inhalation is an extremely efficient way to introduce organic compounds into the bloodstream. Many pesticides cause irritation to the respiratory tract; and sensitization can occur with some: once an individual has become sensitized to a chemical, very small amounts of exposure can cause serious adverse effects [21]. An analysis of 1998-99 data from the State of California's Department of Pesticide Regulation's surveillance system found that respiratory system illness was reported by 23.7% of farmworkers experiencing pesticide-related illness; the route of exposure in 24.2% of pesticide illness cases was inhalation [20].

Studies conducted in countries such as the United Arab Emirates [22], Ethiopia [23], the

Philippines [24], and New Zealand [25] have demonstrated significant associations between pesticide exposure and a host of respiratory health problems.

Certain pesticides have a strong likelihood of causing respiratory disease because of their mechanism of action. For example, chloropicrin, is a fumigant used on strawberries, tomatoes and nursery plants in California, and is often added to other pesticides as a safety agent because it has a strong odor. However, it is also a component of tear gas and is highly irritating to the nose and respiratory tract. Chloropicrin is highly acutely toxic and has been linked to chronic respiratory disease [21]. The lung is the main target organ for the herbicide paraquat [10], and even strictly dermal exposure can lead to respiratory failure [26], and fatal pulmonary fibrosis [16]. It has been linked with pulmonary function deficits among farmworkers exposed in the course of ordinary field activities in Costa Rica [27] and South Africa [28]. Use of paraquat, and also carbamate pesticides, was found to increase prevalence of allergic rhinitis among grape farmers in Greece [29]. While organophosphates (OP) do not specifically target the lungs, respiratory failure as a result of nervous system damage is an endpoint of OP poisoning [16].

Prenatal and early childhood exposure to pesticides is being investigated as a contributing factor in the increasing prevalence of childhood asthma worldwide [30]. This is an important consideration for farmworkers due to the documented issue of the “take-home” pathway that exposes children of farmworkers to pesticide residues in their homes [31-35]. Children can also be exposed to pesticides prenatally if farmworker women are not adequately protected when working in treated fields while pregnant [36;37], with a variety of negative health effects for the infant [38;39]. Prenatal exposure to DDE, an organochlorine pesticide, has been linked to asthma and persistent wheeze by the age of six years [40;41], as has early childhood exposure to DDE and other pesticides [42-44].

In the US, a large-scale longitudinal study known as the Agricultural Health Study is being conducted with nearly 90,000 growers and pesticide applicators and over 25,000 spouses on the effects of pesticides and human health [45]. The study is analyzing the association of pesticides with a wide variety of respiratory health effects, including asthma, wheeze, farmer's lung (hypersensitivity pneumonitis), and bronchitis [46]. Although the study does not include farmworkers, the findings provide direction for identifying possible effects on farmworkers' respiratory health. Relevant results from the study thus far include the following:

- Evidence of a strong association of wheeze with exposure to several organophosphates [46]
- Increased prevalence of chronic bronchitis for individuals who have experienced a high pesticide exposure event [47]
- Association of farmer's lung with high pesticide exposure events and use of organochlorines and carbamates, as well as the insecticides DDT, lindane, and aldicarb [48]
- Chronic bronchitis among the women in the study was associated with five pesticides, including paraquat, DDT, cyanazine, dichlorvos, and methyl bromide [49]
- Atopic asthma among the women was highly associated with having both grown up on a farm and applied pesticides at any time [50]

Avian Influenza

In recent years, public health officials have focused attention on the risks posed to human health by the current worldwide outbreak of avian influenza. This epidemic is of particular concern because it involves a virulent strain of the influenza A virus, known as H5N1. While H5N1 mainly affects birds, 383 human cases have been reported since 2003; of those, 63% (241

cases) were fatal [51]. If the current strain of the disease becomes easily transmissible from human-to-human, these workers could transmit the avian flu at extremely high rates to their families and communities. This would be an especially significant problem in rural areas where there are high concentrations of poultry workers [52]. Modeling shows that in a rural situation where 45% of agricultural workers are infected, they could foster a sharp increase in flu infections by 86% [53].

Poultry workers in the US may be family members of farmworkers living in agricultural areas, or may even be farmworkers themselves, working in poultry between crops. Poultry workers are at risk for avian flu because they have direct contact with birds on a daily basis. As such, they need to be explicitly considered in federal, state, and local plans for preventing and/or handling an avian flu pandemic.

Bird flu has appeared in many countries, including Azerbaijan, Cambodia, China, Djibouti, Egypt, Hong Kong, Indonesia, Thailand, Turkey and Vietnam. It is believed to be spread from country to country by wild birds that infect domestic poultry. The virus is contained in bird blood, droppings (litter), and respiratory secretions. Birds can be sick for three to seven days before they exhibit any signs of disease, and they may die suddenly without any evidence of disease at all. Signs of infection in birds include lack of coordination, purple discoloration of the wattles, combs and legs, soft-shelled or misshapen eggs, lack of energy and appetite, diarrhea, swelling of the head, eyelids, comb, wattles and hocks, nasal discharge, cough and sneezing.

People become infected through contact with bird litter (droppings), sick or dead birds, or contaminated surfaces. Human-to-human transmission may have occurred in a small number of cases. Signs and symptoms in infected people are similar to those of human flu, and include

fever, cough, sore throat, eye infections, muscle aches, pneumonia, acute respiratory distress and other severe and life-threatening complications. Because of the virus's structure, if an individual is simultaneously infected by both the avian flu and a human flu virus, the two could swap genes, creating an avian flu virus capable of spreading easily from person-to-person. If such a mutation occurs, a worldwide human pandemic would rapidly ensue.

Poultry workers are on the front line of risk for avian flu because they routinely handle live or sick birds. These workers typically get covered by bird litter or dust in the course of the day, and workplace hygiene is often poor. In these circumstances, the workers could become infected through contact with bird droppings or contaminated surfaces. Workers who then come home covered by bird litter or dust could easily spread the infection to their family members. Modeling shows that vaccinating 50% of poultry workers against pandemic influenza would prevent an increased risk for avian flu in workers' communities [52]. Most recent CDC guidelines recommend that agricultural workers receive the human influenza vaccine in the event of a human-avian flu pandemic.

Recommendations

- Environmental histories should be a routine part of medical screening for farmworker patients and their families for prompt identification of respiratory health risks. Migrant Clinicians Network suggests the following questions be included in patient intake interview questionnaires [54]:
 1. (Occupation) Describe what you do for work.
 2. (Activities and Cause) Are there any physical activities that you do – at work or away from work – that you feel are harmful to you?
 3. (Substances/Physical Hazards and Cause) Are you exposed to chemicals, fumes, dusts, noise, and/or high heat at your work or away from work? Do you think these are harming you?

- Health care providers should familiarize themselves with the agricultural activities that occur in their region in order to identify possible agents [2], and be alert for relevant respiratory symptoms [6].
- Smoking should be discouraged since it increases risk of reduced lung function [2;13;16].
- Patients who work with either live or dead poultry should be educated on the importance of wearing a respirator or NIOSH-certified dust mask (not a hardware store dust mask).
- Patients who apply pesticides should be reminded to follow the label instructions regarding use of respirators and other personal protective equipment.
- Workers should be vaccinated against human flu, especially if they work with poultry or live with poultry workers, to reduce the risk of simultaneous infection with avian flu.

For More Information:

Schenker MB, et al.: Respiratory health hazards in agriculture. *American Journal of Respiratory and Critical Care Medicine* 158(5):S1-S76, 1998. Includes a comprehensive and more technical review of occupational respiratory disease in agriculture, as well as an extensive list of references.

Beyond Pesticides: *Asthma, Pesticides, and Children: What you should know to protect your family*. Washington, DC: Author. Accessed June 19, 2008 at www.beyondpesticides.org/children/asthma/asthma%20brochure%20high%20res.pdf.

Pesticide Action Network North America: *Secondhand Pesticides: Airborne Pesticide Drift in California*. San Francisco, CA: Californians for Pesticide Reform. Accessed June 19, 2008 at www.panna.org/files/secondhandDriftAvail.dv.html.

Farmworker Justice Health and Safety Resources: <http://www.fwjjustice.org/Health&Safety>. Includes clinical fact sheets and patient education brochures on avian flu.

Liebman, A and Rowland, M. To Ask or Not Ask: The Critical Role of the Primary Care Provider in Screening for Occupational Injuries and Exposures. *Journal of Public Health Management and Practice*, forthcoming. Includes additional information on occupational and environmental health screening for clinicians.

National Environmental Education Foundation. *Health and Environment Publications* (webpage). Includes links for documents on pediatric environmental screening and environmental health practice and education guidelines for medical and nursing professionals. <http://www.neefusa.org/health/pubs/index.htm>. Accessed 07/31/08.

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