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Respiratory Fit Testing for Farmworkers in the Black Dirt Region of Hudson Valley, New York

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ABSTRACT. Respiratory protection in agriculture has lagged behind other industries. Migrant farmworkers often work in dusty environments yet do not receive appropriate, fitted respiratory protection. During May and June of 2013, researchers pilot-tested a respiratory protection program adapted to fit the unique needs of migrant and seasonal farmworkers. It was implemented in Spanish, with literacy support, at convenient times and locations. Additionally, staff was known to workers, and a farmworker medical center provided medical follow-up. Fifty-six farmworkers participated (68%; 82 invited). Of the participants, 88% were male; 20% reported using respiratory protection. One worker had been fit tested previously; 57% reported being exposed to pesticides. All but six farmworkers passed the medical clearance (91%). The mask most commonly fit to the American-born population was a good fit for only 41% of Latino farmworkers. The fact that two thirds of invited farmworkers participated in the clearance and over half completed mask fitting indicates that the modified protocol meets farmworker needs. A wide range of mask types should be made available for Latino farmworkers.

KEYWORDS. Migrant farmworker, respiratory fit testing, respiratory illness, respiratory protection

INTRODUCTION

Respiratory hazards are common in agriculture: particulate, especially aerosolized organic material, chemicals, toxic gases, and low-oxygen spaces all have the potential to cause disease, injury, and disability. Steps to reduce these exposures include hazard containment,

improved ventilation, and, for some hazards, personal respiratory protection. Although personal respiratory protection should only be used when avoidance or engineering controls are not adequate,¹ in many cases it is the only available option.²

Although a great deal of attention has been devoted to respiratory hazards associated with

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chemicals³⁻⁵ and organic dusts on livestock operations,⁶⁻⁹ less is known about respiratory hazards on crop farms. Research by Schenker and colleagues^{10,11} is unique in focusing on inorganic dust damage to the lungs of harvest workers in California working predominantly with field crops. Although not formally studied, the problem is likely different for workers in “mucklands” where up to 80% of the soil consists of extremely fine organic particulate. These regions of primordial swampland are renowned for their agricultural productivity and also for the extreme friability of their soil. When the wind blows across the fields of the “black dirt” regions of New York State, large black clouds of dust with attendant respiratory and eye irritation are common.

Recommendations for respiratory protection of agricultural workers are similar to those for workers in other industries: any worker in an environment with “nuisance” dust, in a concentration greater than 15 mg/m³,¹² should wear a filtering face piece (N95), such as the Moldex 2300 or the 3M 8511 disposable respirator.¹³ Preliminary data reported previously on respirator use by farmers and agricultural workers with pesticide use suggested modest rates of respirator use, with workers consistently exceeding farm owners, and a uniform absence of actual fit testing.¹⁴ Researchers hypothesized that both use and fit rates would be quite low in the immigrant farmworkers of Orange County, New York’s Black Dirt region for three main reasons:

Communication: Given the language and cultural differences, there would be challenges with effectively educating on respiratory protection, and establishing the clear dialogue needed to navigate the medical clearance (including Occupational Safety and Health Administration [OSHA] questionnaire) and fit testing process.

Logistics: Migrant farmworkers work demanding hours, may be paid piece rate, and frequently have no means of transportation. Missing much work time for respirator evaluation and teaching is not viewed as feasible. Further, completion of medical referrals and follow-up visits are often quite challenging in this population of workers.

Participation: Migrant farmworkers frequently have concerns about using personal protective equipment or having a medical evaluation because they do not want to appear unfit to work. They may also be concerned about the cost of the equipment, the time involved, or the procedures they will undergo during the process. Any of these factors may cause migrant and seasonal farmworkers, particularly those without documentation, to not want to participate in the program. As with many other programs, workers may feel it is in their interest to keep a low profile and not attract unwanted attention.

The purpose of the current analysis is to describe the results of a small pilot respiratory protection program designed to optimize the efficiency of providing migrant farmworkers in the Black Dirt region of New York State with appropriate, fitted respirators. Specifically, researchers were interested to know baseline rates of respirator use, the exposures to chemicals, extent of previous fit tests among those using masks, proportion of mask users using disposable respirators, and the willingness of farmworkers to participate in the fit test process. The goals of the respiratory protection effort with this population, in order of priority, were (1) provide workers with appropriate training and suitable, fit-tested respirators; and (2) complete a protocol that assures compliance with OSHA respiratory protection regulations. Observations on revisions to the customary protocol and the results will inform future respiratory fit testing programs for the Spanish-speaking farmworker population.

MATERIALS AND METHODS

Recruitment

Vegetable farms in the Hudson Valley region of New York State were invited to participate in the pilot. The authors had a working relationship with these farms due to previous agricultural health and safety programs held in the region. Ten agreed to participate. Between May and June 2013, the New York Center for Agricultural Medicine and Health (NYCAMH) research staff

visited participating farms and made educational presentations that included an invitation to be fit tested.

Fit Testing Protocol: Modifications From the Standard Design

The standard fit testing protocol was modified in several important ways to enhance appropriate training and suitable fitting of migrant and seasonal farmworkers.

First, the training team was expanded to allow training in both English and Spanish. These staff persons were familiar with the farms and able to train at a community center adjacent to a migrant health center and also in farmworker camps, thereby reaching farmworkers at times when fit testing would be most convenient for them. In some cases, researchers presented the educational portion of the program and then arranged the fit testing at a later date. Second, the exposure and medical history survey portion of the fit test was completed with assistance from project staff. One staff person read the form, and two staff persons could write in the responses provided verbally by the workers. Third, respiratory function was measured using a portable peak flow meter instead of spirometry. The NYCAMH fit testing protocol typically calls for spirometers to measure forced expiratory volumes as a screen for underlying respiratory disease that might be sufficiently severe to hinder use of a respirator. Although less precise and less informative, peak expiratory flows have been found reliable in ruling out the severe lung function problems that would inhibit safe respirator use.¹⁵ Inexpensive hand-held peak flow meters are easy to use in any environment, require less training of either participants or staff, and their use significantly reduces the logistical limitations of the fit test process in agricultural settings. Lastly, although the program was undertaken in close collaboration with the nearby migrant health center so that any medical referrals might be accomplished readily, the process of training, questionnaire administration, peak flow assessment, and fit testing was completed in one visit with provisional clearance, pending subsequent medical examination when indicated.

Fit Testing Administration and Data Collection

Training, medical assessment, and fit testing were completed in a manner compliant with federal guidance.¹⁶ Once informed consent was completed, researchers made a 15-minute presentation that included agricultural respiratory hazards, the role of respiratory protection, and how the medical clearance and face fitting process worked. Participants were shown a variety of masks and invited to ask questions about different features. This was presented in a low-literacy, Spanish language format, with low-literacy print materials.

Next, each participant was given an OSHA medical clearance survey form (in Spanish), and the trainer read each question to the group one at a time. Staff members were available to assist any participant with writing answers on the form. The OSHA questionnaire provides information on demographics, smoking, work history (including past and current exposures), history of respirator use and fit testing, and cardiorespiratory symptoms and related health conditions. Work status (farm owner vs. farmworker) was noted. Next, each participant completed three forced respiratory exhalation maneuvers from maximal inspiration into a peak flow meter. The measured maximum flows obtained from each of these maneuvers were recorded. Under the direction of the team pulmonologist (J.M.), researchers assessed participants' highest peak flow value according to age and height.¹⁷ Participants with maximum values below 65% the standard normal value for their age, gender, and height were referred to Hudson River HealthCare for further evaluation. Participants reporting smoking, lung symptoms, or other major health conditions on the OSHA questionnaire were also referred for medical follow-up. Regardless of these findings, all participants who completed questionnaire and peak flow were immediately fit tested for the type of mask appropriate for their work as identified through the exposure history component of the OSHA survey.

The two-step mask fit test process followed OSHA specifications precisely. First, a candidate mask was placed over the nose and mouth

of the participant, and the fit was visually inspected (user seal check). The fitter looked for gaps between the skin and the mask. If gaps were observed or the participant found the mask uncomfortable, a different type of mask was tried. The participant was asked to move his or her head from side to side and perform other typical movements. Once good contact and comfort was obtained, the participant was asked to blow out to check for gaps around the mask where air could enter or escape. The fitter then observed whether the participant had any difficulty breathing and whether gaps or other fit issues were apparent. Finally, the mask would be tested using qualitative fit testing, whereby a hood was placed over the masked participant and a harmless bitter tasting aerosol solution was sprayed in the hood. If the participant reported being able to taste the solution while performing a set of OSHA-specified exercises, then the mask would fail the test (participants were given a pretest to verify that they could in fact taste the substance). This process continued until a mask was identified that would not allow the airborne material to be tasted.¹⁸

Data Analysis

All of the relevant data points were recorded on each participant's OSHA survey, and then data were entered in to Microsoft Access. Simple aggregations of all 56 farmworker participants were made to provide descriptive statistics. Informal qualitative feedback was also collected from the project staff administering the fit testing program (S.W., J.S.). This study was approved by the Mary Imogene Bassett Hospital Institutional Review Board.

RESULTS

Study Population

Fifty-six farmworkers participated in the fit testing process (2 did not complete peak flow test and 12 did not complete mask fitting). A total of 30 educational presentations were made, 11 at the Alamo Farmworker Community Center, 10 at farmworker camps, and 6 on the farm (in barn, house, or shed) (3 missing).

TABLE 1. Attributes of the Sample, Hudson Valley, New York, 2013 (*N* = 56)

Attribute	Value
Percent male	88% (49)
Mean age	33.2 years
Age range	15–81 years
Spanish language surveys	98% (55)
Body mass index	
Underweight (BMI: <18.5)	2% (1)
Normal weight (BMI: 18.5–24.9)	56% (25)
Overweight (BMI: 25–29.9)	24% (11)
Obese (BMI: ≥30)	18% (8)
Missing data	(11)
Currently smoke	7% (4)
Number of camps visited	10
Range of workers per camp	1–12
Median number of workers per camp	4
Mean years on job	6 years
Range of years on the job	0–50 years

Eighty-two farmworkers were exposed to the educational component, with 56 then proceeding on to the medical clearance survey (68%). Forty-two then completed mask fitting (51%). The 56 participating workers were largely male (88%), and almost all preferred their survey to be in Spanish (98%). Table 1 shows a range of other participant characteristics.

Baseline Behaviors and Exposures

Nearly one fifth (11) reported using respiratory protection in their work. In contrast, only one worker (1.8%) reported having ever been fit tested. Although relatively few farmworkers reported mixing or applying pesticides (13%), a majority reported being exposed to pesticides in some manner (57%). Loud noises (30%), rock dust (16%), welding fumes (11%), and ammonia (7%) were other reported exposures.

Health Conditions and Smoking

Of the 56 completing the survey, 13 (23%) reported one or more behaviors or health conditions for which further evaluation was warranted. Of these, 10 had one or two behaviors/conditions, whereas 3 individuals had between six and nine behaviors/conditions. Health risk behaviors and health conditions included smoking (*n* = 4), diabetes, stroke, and

FIGURE 1. The Orange County “black dirt” region experiences significant dust storms, due to high winds and fine, powdery soil.



hypertension ($n = 1$ each), and several respiratory symptoms.

Peak Flow Values

Of the 54 completing peak flow assessment, 50 participants (93%) had peak flow values that were at least 65% of age and height adjusted norms. Overall, peak flow values ranged from 57% to 128% of normal values, with six failures (failing values range: 57%–61%). For males ($n = 48$), the range was 58% to 128%, and the median was 78% (five failures). For females ($n = 6$), the median was 93% of predicted normal (one failure). The six failing cases were referred for medical follow-up.

Mask Fit

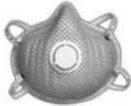
Of the 56 participants undertaking the pre-fit testing survey, 42 (75%) were successfully fit tested for a mask. The remaining one quarter

of participants declined the mask fitting because they did not feel they had enough time to complete it or because they were uncomfortable with having a hood placed over their heads. Trainers noted several instances where participants were initially willing to undertake face fit testing, and then after they saw another individual being fit tested with the hood, they changed their minds (see Figure 1). Of the masks, the one most commonly fit successfully was the 3M 1860 ($n = 16$, 41%). Table 2 below shows the distribution of mask types fit to farmworker participants.

DISCUSSION

These data support our working hypothesis that although use of respiratory protection is modest, fit testing is essentially nonexistent. Our study results show that although nearly 20% (11 participants) reported using respiratory

TABLE 2. Mask Types Successfully Fit to Farmworker Participants Hudson Valley, New York, 2013 ($N = 42$)

Make and model	<i>n</i>	% (N95 types)	Appearance
3M 1860	16	41%	
Moldex 2300	12	31%	
3M 8210	6	15%	
North 7700 series half mask (chemical exposure)	3	NA	
NS23643	3	8%	
3M 8511	1	3%	
Moldex 2301	1	3%	
	42	100%	

protection, only 1 reported having had a fit test. This documents a troubling problem: “respiratory protection” commonly used by farmworkers has not been appropriately fit to them. Moreover, our experience working with this population has shown that “protection” often consists of single-strap paper masks or bandanas, which offer minimal protection. Latino migrant farmworkers demonstrate a different pattern of masks that fit than what we have observed among the almost entirely US-born/non-Latino population we have fit tested over the last 20 years: The Latino migrant farmworkers in this study appeared to have a greater diversity of best-fitting mask types. As a

result, Latino migrant workers may be in even greater need of fit testing than US-born workers.

It appears likely that the modifications to the authors’ usual respiratory protection protocol enhanced both the feasibility and impact of the program. The use of peak flow meters enabled testing in the field (sometimes literally) by staff with lower levels of training. The cutoff of 65% of predicted appears conservative and, like most practices in this respiratory assessment process, is arbitrary. Although the use of peak flows is fairly novel, experts have previously suggested cutoffs of 50% of predicted FEV₁ (forced expiratory volume in 1 second) or FVC (forced vital capacity) without a substantial evidence base.¹⁹ Although the practice of completing fit testing regardless of questionnaire/peak flow outcomes may result in fitting masks to some who aren’t medically cleared to use them, very few farmworkers fit this definition; thus, this possibility is outweighed by the number of farmworkers who would be lost to follow-up and never fit if they had to wait for medical clearance first. Although the usual protocol is to wait until participants have passed the medical evaluation questionnaire and the respiratory capacity testing before fitting them with a mask, our modified protocol fit them before completing the evaluation. Since the vast majority of those identified by these screening measures prove suitable for respirator use,²⁰ the risk involved here is far less than the risk of not protecting workers.

The time that respiratory fit testing takes is a clear disincentive for farmworkers. Although our protocol modification shortened the fit testing waiting time considerably, one quarter of participants still failed to complete fit testing, largely due to the time involved. Further experimentation with ways to make the process less time consuming is needed.

The hood used in qualitative facial fit testing was also a problem. Some workers declined to be face fit tested only after they saw their coworkers under the hood. When this occurred, there was no evidence that the participant under the hood was experiencing any discomfort or distress. Alternative methods for seal checking, such as the quantitative Portacount (TSI, Shoreview, MN, USA), which obviates the need for hoods and taste testing, should be explored

further, although its suitability in farm settings and work camps needs to be assessed.

Over the past 5 years, NYCAMH has completed fit tests on approximately 10,000 volunteer firefighters, farmers, and other rural workers. Due to the demographics of our region, this population is almost entirely US-born and non-Latino. Although anecdotal, our experience is considerable and it provides some frame of reference for the observations of the Latino migrant farmworker population observed in this pilot study. The distribution of mask types successfully fit to the farmworkers is notably different than masks that fit our firefighter population. The 3M model 1860, which fit 16 farmworkers (41% of all farmworker N95 mask fittings), is typically fit to approximately 90% of our volunteer firefighter population. In our experience, roughly 90% of US-born participants can be successfully fit to the 3M 1860. The fact that this was not the case for the Latino migrant farmworkers underscores the importance of (a) fit testing all of these workers; and (b) having access to a number of different models when fitting this population.

Overall, the fact that over two thirds of invited migrant and seasonal workers undertook fit testing and over one half completed it is a hopeful sign. The project staff implementing the program believe that a key part of their success was the fact that fit testing was done in small groups (in Spanish), and that staff were already known to the workers. Additionally, the focus upon a simple evaluation leading to immediate fit testing was important in providing fitted respirators to as high a proportion of participants as possible. Although every effort was made to provide prompt local referral for participants for whom medical examination was required by OSHA, this was done with the recognition that a high proportion might be lost to follow-up.

Limitations

Because this study was a small pilot, these results must be interpreted with caution. Workers of different ethnicities, or working in different regions or with different crops types, may not have the same reactions to fit testing observed here. Relative to large operations in the

western United States, these operations were all quite small. Very large farms are likely to have more formal respiratory protection programs that are more similar to other industries.

CONCLUSION

Increased outreach to provide respiratory fit testing to migrant, seasonal, and immigrant farmworkers is clearly needed if workers are to be fully protected. Programs that build on known principles of migrant farmworker outreach—culturally and linguistically appropriate education, accommodation of farmworkers' unique work, housing and transportation limitations, and a personal approach to help overcome hesitations about participation—are likely to be most successful. Programs targeting Latino migrant farmworkers should offer a wide range of respiratory face mask options, and should focus upon getting fitting completed efficiently in one visit, since follow-up may be problematic.

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