HHS Public Access

Author manuscript

Arch Environ Occup Health. Author manuscript; available in PMC 2016 January 01.

Published in final edited form as:

Arch Environ Occup Health. 2015 ; 70(1): 63–66. doi:10.1080/19338244.2013.787965.

Airway Obstruction Among Latino Poultry Processing Workers in North Carolina

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Abstract

This analysis was conducted to evaluate the prevalence of airway obstruction among Latino poultry processing workers. Data were collected from 279 poultry processing workers and 222 other manual laborers via spirometry and interviewer-administered questionnaires. Participants employed in poultry processing reported the activities they perform at work. Participants with forced expiratory volume in 1 second (FEV_1) or FEV_1/forced expiratory volume (FVC) below the lower limits of normal were categorized as having airway obstruction. Airway obstruction was identified in 13% of poultry processing workers and 12% of the comparison population. Among poultry processing workers, the highest prevalence of airway obstruction (21%) occurred among workers deboning chickens (prevalence ratio: 1.75; 95% confidence interval: 0.97, 3.15). These findings identify variations in the prevalence of airway obstruction across categories of work activities.

Keywords

agriculture; airway obstruction; emigrants and immigrants; epidemiology; minority health; rural health; work

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Epidemiologic research into the health of workers in the poultry production industry has reported adverse occupational health outcomes in the largely minority and immigrant poultry processing workforce in North Carolina.[1–5] In previous analyses, we reported low prevalences of nasal and respiratory symptoms among Latino men and women working in poultry production,[3] suggesting the role of an asthma-specific healthy worker effect.[6] Despite the low prevalence of self-reported symptoms, the lower lung function observed among men employed in poultry processing suggests that poultry processing work may affect lung function.[3] We conducted these additional analyses to investigate the prevalence of a specific lung function outcome, airway obstruction, in the same population of Latino workers.

Methods

We conducted an epidemiologic analysis using data collected from a cross-sectional study designed to assess the health of Latino men and women employed in poultry processing jobs in North Carolina. The study design and methods are described in detail elsewhere.[3] Poultry processing workers were eligible for inclusion if they were adults who self-identified as Latino or Hispanic and were working in poultry processing ≥35 hours per week at the time of recruitment. Participants in the comparison population were employed for pay in manual jobs, excluding jobs in poultry processing or production. Recruitment was limited to the geographic areas surrounding 3 poultry processing plants in western North Carolina. Quality control workers in poultry processing plants and workers in other chicken production occupations (eg, chicken catchers) were excluded from the study.[3]

Between May 2009 and November 2010, data were collected via in-person, interviewer-administered questionnaires and data collection clinics held within 1 month of participants completing the questionnaire. Questionnaires and spirometry testing were completed by 289 poultry processing workers and 229 other manual laborers.[3] Spirometry was conducted using EasyOne diagnostic spirometers (ndd Medical Technologies, Zurich, Switzerland). Experienced technicians performed all spirometry testing with the assistance of study personnel who explained in Spanish, as needed, the purpose of the test and the testing procedures. Data from all forced exhalation maneuvers were saved and later reviewed by study personnel (A.B.C., M.C.M.). We excluded 10 poultry processing workers and 7 other manual laborers whose spirometry testing yielded unusable results. Our final study population for this analysis includes 279 workers employed in poultry processing and 222 members of the comparison population. The Wake Forest University Health Sciences institutional review board approved the study. All participants provided written informed consent.

Each participant employed in poultry processing responded to survey questions about the length of time he/she had been employed in poultry processing, the job activities currently performed on the job, and the length of time performing those current activities. As in previous analyses,[3] and because of the small number of participants reporting several of the individual poultry processing activities, activities were grouped, as shown in Table 2. Participants who reported performing job activities in more than one grouping were included in each group. To evaluate the impact of including participants in more than one category on

our final results, we conducted sensitivity analyses using a revised classification system in which participants who reported one activity were categorized according to that activity and participants who reported more than one activity were categorized into a single category of participants performing multiple job activities.

We categorized each participant's airway obstruction status based on the results of spirometry testing. Participants with forced expiratory volume in 1 second (FEV_1) less than the lower limit of normal (LLN) or the ratio of FEV_1/forced vital capacity (FVC) less than LLN were categorized as having airway obstruction. For each participant, FEV_1 and FVC values used were the best values obtained from all exhalation maneuvers. Values for LLN were computed using age- and sex-specific reference equations for Mexican–American adults.[7]

Each participant reported his/her age, country of birth, history of asthma, and smoking status. We categorized smoking status as lifetime nonsmoker, former smoker, or current smoker. Participants who reported smoking cigarettes within the last month were categorized as current smokers; those who reported ever smoking, but not within the last month, were categorized as former smokers; the remaining participants (ie, those who reported never having smoked cigarettes) were categorized as lifetime nonsmokers. The association between employment in poultry processing and airway obstruction was estimated using binomial regression, adjusted for history of asthma and smoking status. Associations between each of the poultry processing activities and airway obstruction were estimated using a similar adjusted binomial regression model. All statistical models accounted for the clustering of participants within housing units and recruitment sites. Associations are presented as prevalence ratios (PRs) with 95% confidence intervals (95% CIs). All analyses were conducted using SAS version 9.3 (SAS Institute, Inc., Cary, NC).

Results

Table 1 shows demographic characteristics of the populations. In both groups of workers, approximately 3% reported a history of asthma and over 70% were identified as lifetime non- smokers. Based on the results of spirometry testing, 13% of the poultry processing population and nearly 12% of the comparison population were categorized as having airway obstruction.

Of the 279 poultry processing workers in our study, 275 reported the length of time he/she was employed in poultry processing (mean ± *SD*: 5.2 ± 4.4 years; median: 4; range: <1 to 23). Mean (± *SD*) years spent performing any poultry processing activity grouping ranged from 2.3 (2.0) in receiving, hanging, killing, plucking to 4.1 (3.9) in sanitation (Table 2).

Overall, performing any poultry processing work was not associated with airway obstruction (PR: 1.10; 95% CI: 0.70, 1.74). The prevalences of airway obstruction among workers performing specific poultry processing activities are shown in Table 2. The highest prevalences were found among workers performing deboning (21%) and sanitation (17%). Adjusted for history of asthma and smoking status, and taking into account the clustered recruitment of study participants, the highest prevalence of airway obstruction relative to

that of the comparison population was generated for deboning (PR: 1.75; 95% CI: 0.97, 3.15).

Our sensitivity analyses identified 54 workers who reported performing activities in 2 or more categories. Repeating our analyses with this revised classification of poultry processing tasks generated PRs similar to those in our main analyses (eg, deboning: PR: 1.74; 95% CI: 0.92, 3.28). Seven (13%) of the 54 poultry processing workers who reported performing job activities in multiple categories were identified as having airway obstruction (PR: 1.03, 95% CI: 0.37, 2.86).

Comment

This study did not identify elevated risk of airway obstruction in the population of workers employed in poultry processing compared with the population of other manual laborers. However, analysis of specific poultry processing job tasks identified variations in the prevalence of airway obstruction across categories of tasks, with most notable elevations among workers who reported deboning and sanitation activities and lowest prevalences among workers performing wash-up and "other activities." Such variations suggest that all workers in poultry processing facilities may not be adequately protected from potential inhalation hazards on the job. This conclusion is supported by our earlier observation of lower lung function observed among men employed in poultry processing, particularly among men who reported performing sanitation activities,[3] and by findings of elevated respiratory symptom prevalences among poultry processing workers exposed to soluble chlorine.[8] Results of the present analysis extend those observations by reporting the prevalence of one specific and important pulmonary outcome, airway obstruction, in a population of Latino workers.

Partial obstruction of the airways may occur in several ways, including blockage due to excessive secretions into the airway; contractions of the smooth muscles of the airways; thickening of the airway walls; and introduction of foreign materials into the airways.[9] In poultry processing facilities, workers may encounter biological and chemical inhalation hazards[10–12] and reactions to respiratory irritants or allergens may trigger inflammation of the airway wall and the production of mucus in the airways.[9] These reactions may plausibly produce the outcomes categorized in the present study as airway obstruction regardless of whether the participant reports respiratory symptoms or a history of asthma. In fact, in previous analyses, we did not observe an elevated prevalence of asthma in the poultry processing population.[3] These earlier findings, in combination with the prevalence of airway obstruction reported here, support a hypothesis regarding the role of a respiratory-specific healthy worker effect in which workers with acute respiratory responses to the inhalation hazards encountered in poultry processing facilities may no longer be employed in jobs such as these.[3] If employment in poultry processing work overall or a worker's ability to perform specific poultry processing activities were affected by such a phenomenon, then the airway obstruction observed in this population may indicate an underrecognized chronic obstructive phenotype of respiratory disease.

Limited epidemiologic data are available with which to contrast our findings. Although extensive reviews are available to describe associations of obstructive lung disease with occupational dust exposures,[13–16] few studies have been conducted among animal processing workers. Additional information about the inhalation exposures encountered in poultry processing, the use of personal protective equipment, and workers' ability to rotate out of job activities that elicit health symptoms would improve our characterization of poultry-related exposures potentially associated with obstructive airway disease. Improvements in exposure assessment related to inhalation exposures in both the poultry processing and comparison populations would reduce the extent to which exposure misclassification affects our results. Despite the small number of participants identified with airway obstruction, notable strengths of our study include the large number of participants who completed spirometry testing, objective measurement of lung function, and review of each participant's spirograms by study personnel.

Poultry processing provides jobs for individuals with minimal education and limited ability to communicate in English, but little information is available about working conditions inside poultry processing plants. If air inside the facilities includes inhalation hazards, then workers may be at risk of developing or exacerbating obstructive airway disease. Task-specific inhalation exposure assessment would improve the interpretation of variation in the prevalence of airway obstruction observed. Access to poultry processing facilities would enable direct observation and measurement of work conditions, including indoor air quality, potential inhalation exposures, and use of personal protective equipment; however, such exposure assessment in occupational health studies of poultry processing continues to be a challenge.

Acknowledgments

Funding

This research was funded by the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention (grant no. R01OH009251).

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Table 1

Characteristics of the Study Population and the Prevalence of Airway Obstruction

		Poultry processing workers			Comparison population		
	Total population		With airway obstruction			With airway obstruction	
Characteristic	***n***	***n***	***n***	**%**	***n***	***n***	**%**
Total	501	279	37	13.3	222	26	11.7
Age, years							
Mean	34.6	36.4	34.1		32.4	30.1	
SD	10.4	11.2	11.5		8.8	7.2	
Min–Max	18–68	18–68	19–63		18–60	18–52	
Country of birth							
Guatemala	171	106	17	16.0	65	8	12.3
Mexico	269	124	11	8.9	145	15	10.3
Other	61	49	9	18.4	12	3	25.0
History of asthma							
No	487	272	36	13.2	215	22	10.2
Yes	14	7	1			14.3 7 4	57.1
Sex							
Female	224	124	9	7.3	100	8	8.0
Male	277	155	28	18.1	122	18	14.8
Smoking status							
Current smoker	67	35	4	11.4	32	6	18.8
Former smoker	76	47	7	14.9	29	2	6.9
Lifetime nonsmoker	358	197	26	13.2	161	18	11.2

Table 2

Associations Between Poultry Processing, Job Activities, and Airway Obstruction

		Years in poultry job or activity		With airway obstruction			
Variable	***n***	**Mean**	**SD**	***n***	**%**	**PR[a]**	**95% CI**
Employed in poultry processing							
No[b]	222	—		26	11.7	1.00	
Yes	279	5.2[c]	4.4	37	13.3	1.10	0.70, 1.74
Poultry processing activities[d]							
Receiving, hanging, killing, plucking	34	2.3	2.0	3	8.8	0.70	0.22, 2.18
Cutting, evisceration	64	3.1	2.3	8	12.5	1.04	0.52, 2.09
Wash-up	11	3.6	2.6	0	0.0	__ [e]	
Trimming	46	3.7	3.4	5	10.9	0.88	0.35, 2.18
Deboning	58	3.8	3.6	12	20.7	1.75	0.97, 3.15
Chilling, packing	73	3.9	3.9	10	13.7	1.07	0.56, 2.05
Sanitation	35	4.1	3.9	6	17.1	1.59	0.71, 3.55
Other activities	23	3.2	2.5	1	4.4	0.41	0.06, 2.86

[a] Adjusted for history of asthma and smoking status, and taking into account the clustered recruitment of study participants.

[b] The comparison population is the referent group for both models.

[c] Based on data reported by 275 poultry processing workers.

[d] Participants who reported performing job activities in more than one category were included in each group.

[e] Not estimated.