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# Employer Differences in Upper-Body Musculoskeletal Disorders and Pain Among Immigrant Latino Poultry Processing Workers

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**ABSTRACT.** Between-employer differences in working conditions may lead to variable injury rates. The objective of this paper is to assess the difference in the prevalence of epicondylitis, rotator cuff syndrome, and low back pain among immigrant Latino poultry workers at plants of three different employers. Data were collected from a cross-sectional study among 286 poultry processing workers. Community-based sampling was used to recruit participants in western North Carolina. Rotator cuff syndrome (26.7%) and low back pain (27.9%) were more prevalent among employees of one specific employer. Multivariate analysis showed significant associations of low back pain and rotator cuff syndrome with age, task performed in the processing line, and employer. Employer is a major predictor of musculoskeletal disorders and pain. Line speed and work pace may account for these differences and provide an opportunity for regulation and intervention to protect the health of workers.

**KEYWORDS.** Employer differences, Latino immigrant workers, musculoskeletal injuries

## *INTRODUCTION*

In the United States, approximately 36,643 million pounds of chicken are produced every year, the majority of it in southern states.[1] Chicken processing has gained importance, as the consumption of further processed chicken versus whole chicken has exponentially

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increased over the past decades. The increased marketing and consumption of processed chicken has led to the vertical integration and mechanization of the poultry industry. Such mechanization requires employees to work at high rates of speed for long periods, frequently without breaks. The result is a relatively high risk of injury, with a reported annual rate of 5.7 injuries per 100 full-time workers.[2] In contrast to other less automated occupations that employ immigrant Latinos, the exposures resulting from modern poultry processing may contribute to elevated upper-body musculoskeletal problems.[3–7]

Despite the changes in the poultry processing industry, there are still differences among processing plants that lead to different levels of mechanization throughout the industry.[8] The potential for within-industry differences in injury and illness is substantial. Smaller plants may be less mechanized and have fewer safety precautions in place compared with larger plants. Small profit margins can influence company decisions about training, line speed, protective equipment, and general commitment to safety, all of which can affect injury rates. External monitoring of companies by the Occupational Safety and Health Administration (OSHA) is extremely limited, as less than 1% of workplaces are inspected annually,[9] and selection criteria may miss at-risk plants.[3] Ergonomic and line-speed standards are voluntary, and their enforcement is variable. Worker perception of safety climate varies significantly between poultry processing companies,[5,10] reflecting the cumulative effect of such company-specific factors.

A major obstacle to determining within-industry differences in injury risk is corporate underreporting of injuries.[11,12] Management incentives are often tied to injury rates, a situation that encourages underreporting of injuries.[9] The reporting process must be initiated by the poultry workers themselves, many of whom are immigrant Latinos.[5,13] Their reporting is likely limited by language barriers, fears based on their vulnerable immigration status, and need to work.[5]

Studies designed to circumvent these obstacles in order to accurately assess injury burden across companies in poultry are challenging to execute. Employers are reticent to allow occupational health researchers to screen their workforce.[5,14] Immigrant workers are frequently characterized as "hard to reach" because many lack documents allowing legal residence in the United States, thereby encouraging workers to remain invisible.[5,12]

The goal of this study is to assess differences in the prevalence of epicondylitis, rotator cuff syndrome, and low back pain among immigrant Latino workers at three poultry processing plants in western North Carolina by (1) determining employer differences in exposures; (2) determining if there are employer differences in organization of work; (3) determining if there are employer differences in clinical outcomes; and (4) assessing whether differences in work exposure or organization explain differences in clinical outcomes.

## METHODS

### Study Design

The data for this study are from a larger cross-sectional study focused on occupational illness and injury among manual immigrant workers. Previous papers from this project have described the prevalence of carpal tunnel syndrome,[7] respiratory outcomes,[15] and disability,[16] as well as procedures for sampling and recruitment.

### Sampling

Data were collected in four rural counties in western North Carolina that are considered "new settlement" areas for Hispanic/Latino residents.[17] The issues that Latino immigrants face in the United States make them a complex population with whom to conduct research. The research team did not have access to workplaces, and no census existed of Latino manual workers in the area. Therefore, community-based sampling was used to assure that a representative sample would be selected.[18] A sample frame of dwellings where Latinos lived in the study area was developed. The list of enclaves was created with the help of trusted Latino

members of the communities where the participants were recruited who knew the areas that were highly populated by Latinos. Other areas within those communities were also surveyed to identify other areas likely inhabited by Latinos. To identify those areas, cultural and behavioral indicators that characterized Latino residents (i.e., Virgen de Guadalupe decals on vehicles, particular satellite dishes) were surveyed. A total of 1,526 residents were screened. Inclusion criteria were self-identified as being Latino or Hispanic, worked 35 hours or more per week in poultry processing or other manual labor job, and 18 years or older. Work in poultry processing was defined as any type of nonsupervisory work in a poultry processing plant with job categories from receiving through sanitation. More than one resident per dwelling could be recruited, if eligible. Of the 957 eligible residents, 742 (77.5%) were interviewed and 518 (69.8%) of those interviewed attended a data collection clinic. Two individuals left the clinic prior to completing the physical examination, for a final sample size of 516, of these 286 were poultry workers, which is the group analyzed for this paper.

## *Data Collection*

Data collection involved two distinct encounters with participants. The first encounter was an interviewer-administered survey that took place in participants' homes. During the in-home interview, participants were asked basic demographic information (e.g., age, preferred language), as well as detailed questions about the types of work performed for pay, specific physical occupational exposures (e.g., chemicals, biological fluids), and work organization (e.g., job demands, decision latitude, and support). They received an incentive of $10. The second encounter, a "data collection clinic," took place on a Sunday at seven different locations within the study area during the data collection period. Participants were scheduled for a clinic that occurred within 30 days of the in-home interview. On the day of the clinic, a short questionnaire was administered to assess whether any self-reported pain at the elbows, shoulders, or low back had been experienced on 2 or more days in the last month. Two board-certified physicians with fellowship training in sports medicine conducted 92.6% and 7.4%, respectively, of the musculoskeletal examinations. Rates of positive findings were comparable between the two examiners, suggesting no evidence of examiner effects. Those who attended the clinic that included collection of other physical data were given $30. All procedures were approved by the Wake Forest School of Medicine Institutional Review Board. Signed informed consent was obtained from each participant.

## *Measures*

Outcome measures were diagnoses of epicondylitis, rotator cuff syndrome, and low back pain. Case definitions were similar to criteria outlined by Sluiter et al.[19] Rather than requiring multiple examination findings in addition to self-reported pain, this study required only one positive examination finding. Epicondylitis was defined as self-reported pain at either epicondyle area on 2 or more days in the previous month and one of the following on examination: presence of pain at the lateral epicondyle with resisted active wrist extension, pain at the medial epicondyle with resisted active wrist flexion, or tenderness to palpation over the medial or lateral epicondyle regions.[20] Rotator cuff syndrome was defined as self-reported pain at the shoulder on 2 or more days in the previous month and one of the following on examination: presence of pain with resisted abduction, internal rotation, external rotation, or forward flexion of the shoulder; or tenderness to palpation over the bicipital groove or lateral shoulder. Low back pain was defined as self-reported low back pain on 2 or more days in the previous month and one of the following on examination: presence of pain with active flexion, extension, side-bending to right or left; or twisting to right or left; or tenderness to palpation anywhere in the lumbar region.[21]

Because some poultry worker participants reported multiple poultry processing activities, specific poultry jobs were combined into three categories corresponding to main production areas:[22] those jobs likely to emphasize

fine movements of hands and wrists (cutting, evisceration, trimming, deboning), jobs requiring lifting of whole birds (receiving, hanging, killing, plucking), and other tasks with more varied physical demands (packing, sanitation, wash-up). Tasks performed by participants were assessed by asking them if, at the time of interview, they were working in receiving, hanging, plucking, cutting, evisceration, wash-up, trimming, deboning, chilling, packing, sanitation, or other task within the poultry processing plant. The tasks performed in poultry processing were taken from an ergonomic tool published by the US Occupational Safety and Health Administration.[22]

Work organization was measured using three domains: job demands (heavy load, awkward posture, psychological demand), decision latitude (job control), and support (perceived supervisor power, work safety climate). All the variables used for work organization are presented as continuous variables. Heavy lifting and awkward posture were measured with a physical workload instrument[23] that has been used in previous research with immigrant Latino populations.[24] Response options ranged from "seldom/never" (1) through "almost always" (4). Heavy load was assessed with the average of 12 items ($\alpha = .70$), and awkward posture was assessed by with the average of 6 items ($\alpha = .80$), coded such that higher values indicate greater exposure.

Psychological demand and job control were assessed using items modified from the Job Content Questionnaire.[25] The response options range from "seldom/never" (1) through "almost always" (4). Psychological demand is the mean of four items ($\alpha = .74$). Job control is the mean of three items ($\alpha = .81$). Higher values indicate greater levels for each concept. Each of these measures has been used with immigrant Latino worker populations.[26,27]

Perceived supervisor control was assessed with seven items from an established instrument.[28] The items ask the participant to judge whether their supervisor had control over pay, benefits, promotions, job assignments, and making work difficult. Response ranged from "strongly disagree" (1) through "strongly agree" (4). Used previously,[24] perceived supervisor control is the mean of the seven items ($\alpha = .74$) coded such that higher scores indicate greater perceived control. Work safety climate was measured using the Perceived Safety Climate Scale.[29] Nine of the items in the scale used a 4-point Likert format. The 10th item included three response categories. After an analysis of internal consistency, one of the nine 4-point Likert format items was discarded due to lack of fit within the scale. A total Work Safety Climate was calculated by summing the remaining nine items ($\alpha = .73$). Values for the scale ranged from 9 to 39, with higher values indicating better work safety climate. These measures had been used in previous research with immigrant Latino worker populations.[26,27,30]

Gender and age were asked during the in-home interview, with age classified into one of three groups ($<30$, 30–39, $\geq 40$). Indigenous language (e.g., Quiche, Aguacateco) was assessed by asking individuals the language spoken by adults in the household when the participant was a child. Educational attainment was assessed based upon the grading system used in Latin American countries (i.e., Primaria, Secundaria, Preparatoria, Universidad), and responses were classified as 0–6 years (Primaria), 7–9 years (Secundaria), or $>10$ years (Preparatoria or Universidad). Years lived in the United States was asked and responses were classified as 0–4, 5–9, 10–14, or 15 or more years. Employer was assessed by asking participants the name of the primary company participants worked for, and creating a category for each of the three poultry companies reported.

## *Statistical Methods*

Descriptive statistics (frequencies and percentages) were used to describe the overall study sample by employer. The organization of work by employer was described using means and standard deviations and tested using *F* tests. The association between employer and the prevalence of musculoskeletal disorders and pain and job type was assessed using Rao-Scott chi-square tests. Next, we fit multivariable logistic regression models to examine the bivariate associations between the prevalence of rotator cuff syndrome and low back pain and risk factors

(such as age, sex, work organization, and work type). Adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were reported. Pairwise differences among three different employers (Employer 1 vs. 2, 3 vs. 2, and 3 vs. 1) were estimated using contrasts. Epicondylitis was not analyzed further because there were not enough events to obtain reliable parameter estimates in multivariable models. Finally, because the study adopted a community-based sampling strategy for recruitment, there was clustering among dwelling units within a stratum as well as clustering among participants within a dwelling unit. Therefore, all statistical analyses were adjusted for this stratified cluster sampling design of the study. A $P$ value of less than .05 was considered statistically significant. All analyses were performed using SAS 9.3 (Cary, NC, USA).

## RESULTS

Age of participants was fairly evenly distributed across the three categories. Between-company differences were evident (Table 1): 51.4% of Employer 1 workers were over 40, whereas 62.8% of Employer 3 workers were younger than 30. There were more males (55.6%) overall, but Employer 1 had 58.6% females. A majority of participants spoke a nonindigenous language (76.7%), but Employer 3 had 64.0% who listed an indigenous language. Most reported less than 10 years of schooling (83.9%) and having lived in the United States for 5 or more years (79.0%). Most participants had worked in poultry processing for 4 years or less (57.8%), but this was even more pronounced for Employer 3 (88.2%; none with 10 or more years of experience).

About 8% of the participants had epicondylitis. Rotator cuff syndrome was the most common diagnosis in the overall sample (48 cases), closely followed by low back pain (45 cases) (Table 2). There was a significant association between these two injuries and employer. These injuries were more prevalent among those who worked for Employer 3 and least prevalent among those who worked for Employer 2.

Work organization variables for the overall sample and by employer are described in

TABLE 1. Employee Personal Characteristics by Employer: Poultry Processing Workers

| Characteristic | Total *n* (%) | Employer 1 *n* (%) | Employer 2 *n* (%) | Employer 3 *n* (%) |
|---|---|---|---|---|
| Age | | | | |
| <30 | 89 (31.1) | 15 (13.5) | 20 (22.5) | 54 (62.8) |
| 30–39 | 95 (33.2) | 39 (35.1) | 32 (36.0) | 24 (27.9) |
| 40+ | 102 (35.7) | 57 (51.4) | 37 (41.6) | 8 (9.3) |
| Gender | | | | |
| Female | 127 (44.4) | 65 (58.6) | 33 (37.1) | 29 (33.7) |
| Male | 159 (55.6) | 46 (41.4) | 56 (62.9) | 57 (66.3) |
| Language | | | | |
| Nonindigenous | 217 (76.7) | 104 (95.4) | 82 (93.2) | 31 (36.1) |
| Indigenous | 66 (23.3) | 5 (4.6) | 6 (6.8) | 55 (64.0) |
| Education | | | | |
| 0–6 years schooling | 182 (63.6) | 61 (55.0) | 48 (53.9) | 73 (84.9) |
| 7–9 years schooling | 58 (20.3) | 25 (22.5) | 23 (25.8) | 10 (11.6) |
| 10+ years schooling | 46 (16.1) | 25 (22.5) | 18 (20.2) | 3 (3.5) |
| Years in the United States | | | | |
| 0–4 | 60 (21.0) | 3 (2.7) | 15 (16.9) | 42 (48.8) |
| 5–9 | 68 (23.8) | 15 (13.5) | 23 (25.8) | 30 (34.9) |
| 10–14 | 58 (20.2) | 27 (24.3) | 19 (21.4) | 12 (14.0) |
| 15+ | 100 (35.0) | 66 (59.5) | 32 (35.9) | 2 (2.3) |
| Years in poultry processing | | | | |
| 0–4 | 163 (57.8) | 39 (35.1) | 49 (57.0) | 75 (88.2) |
| 5–9 | 79 (28.0) | 49 (44.2) | 20 (23.2) | 10 (11.8) |
| 10–14 | 25 (8.9) | 14 (12.6) | 11 (12.8) | 0 (0.0) |
| 15+ | 15 (5.3) | 9 (8.1) | 6 (7.0) | 0 (0.0) |

TABLE 2. Diagnosis of Musculoskeletal Injuries Among Poultry Processing Workers by Employer

| Diagnosis | Total *n* (%) | Employer 1 *n* (%) | Employer 2 *n* (%) | Employer 3 *n* (%) | *P* value* |
|---|---|---|---|---|---|
| Epicondylitis | 17 (5.9) | 9 (8.1) | 2 (2.3) | 6 (7.0) | .2203 |
| Rotator cuff Syndrome | 48 (16.80 | 19 (17.1) | 6 (6.7) | 23 (26.7) | .0012 |
| Low back pain | 45 (15.7) | 14 (12.6) | 7 (7.9) | 24 (27.9) | .0007 |

*Rao-Scott chi-square tests.

TABLE 3. Association of Organization of Work Variables and Employer Among Poultry Processing Worker

| Variable | Total ($N = 286$) | Employer 1 ($n = 111$) | Employer 2 ($n = 89$) | Employer 3 ($n = 86$) | *P* value* |
|---|---|---|---|---|---|
| | Mean, ±*SD* | Mean, ±*SD* | Mean, ±*SD* | Mean, ±*SD* | |
| Heavy load | 2.00, ±0.54 | 1.98, ±0.59 | 1.83, ±0.41 | 2.2, ±0.53 | <.0001 |
| Awkward posture | 2.31, ±0.75 | 2.49, ±0.85 | 2.09, ±0.64 | 2.32, ±0.65 | .0012 |
| Abusive supervision | 2.34, ±0.48 | 2.08, ±0.49 | 2.42, ±0.31 | 2.58, ±0.44 | <.0001 |
| Safety climate | 24.90, ±3.05 | 24.00, ±2.21 | 26.16, ±2.23 | 24.74, ±4.14 | <.0001 |
| Job control | 1.68, ±0.78 | 1.69, ±0.84 | 1.79, ±0.77 | 1.55, ±0.68 | .1050 |
| Psychological demand | 2.75, ±0.88 | 2.84, ±0.96 | 2.23, ±0.7 | 3.17, ±0.64 | <.0001 |

*$F$ tests were used to test differences between the means.

Table 3. Participants employed by Employer 3 were more likely to be exposed to lifting heavy loads (2.2 ± 0.53), reported greater perceived supervisor control (2.58 ± 0.44), and greater psychological demand (3.17 ± 0.64). In contrast, participants employed by Employer 2 reported better safety climate (26.6 ± 2.23). Participants employed by Employer 1 reported higher exposure to awkward postures (2.49 ± 0.85).

Job type for the overall sample and by employer is described in Table 4. The largest job type category overall was cutting/eviscerating/trimming/deboning with 47.9%, whereas packing was second highest with 23.8%. The largest proportion of participants working in packing (38.7%) and wash-up and other tasks (14.4%) worked for Employer 1. The largest proportion of participants in sanitation (19.1%) and cutting/eviscerating/trimming/ deboning (62.9%) were employed by Employer 2. Employer 3 had the largest proportion of workers performing tasks in receiving/hanging/killing/plucking (12.8%).

TABLE 4. Task Performed by Poultry Processing Worker and Employer*

| Job types | Total ($N = 286$) | Employer 1 ($n = 111$) | Employer 2 ($n = 89$) | Employer 3 ($n = 86$) |
|---|---|---|---|---|
| | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| Receive/hang/kill/pluck | 23 (8.0) | 10 (9.01) | 2 (2.25) | 11 (12.79) |
| Cut/eviscerate/trim/debone | 137 (47.90) | 32 (28.83) | 56 (62.92) | 49 (56.98) |
| Packing | 68 (23.78) | 43 (38.74) | 8 (8.99) | 17 (19.77) |
| Sanitation | 34 (11.89) | 10 (9.01) | 17 (19.10) | 7 (8.14) |
| Wash-up/other | 24 (8.34) | 16 (14.41) | 6 (6.74) | 2 (2.33) |

*Rao-Scott chi-square $P$ value $< .0001$.

TABLE 5. Multivariate Analysis of Associations of Muscled Skeletal Injuries and Personal Characteristics, Task Performed at Poultry Processing Plan, Work Organization, and Employer

| Variable | Rotator cuff syndrome | | Low back pain | |
|---|---|---|---|---|
| | OR | CI | OR | CI |
| Age | 1.06 | 1.01–1.10* | 1.01 | 0.97–1.05 |
| Gender | | | | |
| Male | Ref | Ref | Ref | Ref |
| Female | 0.17 | 0.06–0.50* | 0.24 | 0.08–0.72* |
| Years in poultry processing | 1.07 | 0.97–1.18 | 1.02 | 0.92–1.13 |
| Education | | | | |
| 0–6 years | Ref | Ref | Ref | Ref |
| 7–9 years | 0.66 | 0.18–2.36 | 0.56 | 0.18–1.75 |
| 10+ years | 1.80 | 0.61–5.34 | 0.60 | 0.17–2.10 |
| Indigenous language | | | | |
| No | Ref | Ref | Ref | Ref |
| Yes | 2.41 | 0.62–9.40 | 0.54 | 0.15–1.94 |
| Task | | | | |
| Cut/eviscerate/trim/debone | Ref | Ref | Ref | Ref |
| Receive/hang/kill/pluck | 3.84 | 1.01–14.61* | 4.68 | 1.11–19.77* |
| Packing | 1.31 | 0.51–3.38 | 0.82 | 0.28–2.41 |
| Sanitation | 1.53 | 0.31–7.61 | 2.45 | 0.56–10.73 |
| Wash-up | 2.68 | 0.70–10.21 | 0.65 | 0.09–4.75 |
| Work organization | | | | |
| Heavy load | 1.26 | 0.55–2.90 | 1.73 | 0.67–4.50 |
| Posture | 1.04 | 0.52–2.08 | 1.63 | 0.83–3.19 |
| Abusive supervision | 0.70 | 0.33–1.48 | 1.26 | 0.51–3.12 |
| Safety climate | 0.99 | 0.88–1.12 | 1.05 | 0.93–1.17 |
| Job control | 2.00 | 0.63–1.90 | 0.97 | 0.54–1.73 |
| Psychological demand | 1.25 | 0.73–2.15 | 0.93 | 0.53–1.63 |
| Employer† | | | | |
| Employer 1 vs. Employer 2 | 1.11 | 0.33–3.73 | 1.17 | 0.36–3.79 |
| Employer 3 vs. Employer 2 | 6.23 | 1.44–27.23* | 4.86 | 1.13–20.92* |
| Employer 3 vs. Employer 1 | 5.63 | 1.43–22.11* | 4.15 | 0.86–19.48 |

†Adjusted for age, gender, years in poultry processing, education, language, task, work organization, and employer.
*$P$ value $< .05$.

There was no difference between employers for epicondylitis prevalence after multiple logistic regression analysis. Age persisted with logistic regression modeling as a significant association with epicondylitis ($P = .01$). The final logistic regression models for rotator cuff syndrome and low back pain are presented in Table 5. For rotator cuff syndrome, age (OR = 1.06, CI = 1.01–1.10), receiving/hanging/killing/plucking (OR = 3.84, CI = 1.01–14.61), and Employer 3 (vs. Employer 2: OR = 6.2, CI = 4.44–27.23; vs. Employer 1: OR = 5.63, CI = 1.43–22.11) remained significant risk factors. For low back pain, receiving/hanging/killing/plucking (OR = 4.68, CI = 1.11–19.77) and Employer 3 (OR = 4.86, CI = 1.13–20.92) when compared with Employer 2 remained significant risk factors. Female gender was a significant protective factor for both rotator cuff syndrome (OR = 0.17, CI = 0.06–0.50) and low back pain (OR = 0.24, CI = 0.08–0.72).

## DISCUSSION

The mechanization of the poultry processing industry has led to increasing line speeds and, therefore, higher musculoskeletal disorders and pain rates among poultry workers. Nevertheless, the musculoskeletal disorders and pain rates can vary by plant. The differences in plant size and production capability may affect the quality of the equipment and the worker safety guidelines implemented at each plant. Evidence exists that

there is a correlation among implemented safety practices and injury rates of workers.[31] The findings of this paper show that, even though there were no clear differences in organization of work among the three poultry processing employers, there are significant associations of rotator cuff syndrome and lower back pain with age, gender, task performed in the processing line, and employer.

Working in receiving/hanging/killing/plucking increased the odds of having rotator cuff syndrome or lower back pain injuries. These tasks require workers to continuously make movements above shoulder level, which could cause rotator cuff syndrome. These findings are supported by previous studies that show a strong correlation among industrial workers working above shoulder level and diagnosis of rotator cuff syndrome.[32,33] Working in some of these tasks also requires workers to flex forward, which has been associated with lower back pain.[34]

Female gender was a protective risk factor for both rotator cuff syndrome and low back pain, whereas age was an independent risk factor for epicondylitis and rotator cuff syndrome. Previous studies have shown a correlation between rotator cuff syndrome and low back pain among women that was mainly attributed to differences in the workload.[35,36] The results in this paper may differ from previous studies due to the difference in tasks that men and women have within the processing line (i.e., men are more likely to work hanging chickens, which requires repetitive over the shoulder movement and forward extension of the lower back). Association between epicondylitis and age is consistent with other studies.[37] Older workers may simply have had greater time for exposure volume to accumulate both on the job and with leisure time activities. For older workers, there may be a greater mismatch between task force requirement and physical strength.

Employer was a major predictor of musculoskeletal disorders and pain. Rotator cuff syndrome and low back pain were more prevalent among participants who worked for Employer 3. This association could not be explained by demographic data, reported exposure to heavy load or difficult posture, or job type differences between these plants. Several factors not accounted for in this study could account for why working for Employer 3 was a risk factor for rotator cuff syndrome and low back pain. Number of hours worked by employees may have been higher for Employer 3. Cumulative exposure to repetitive activity, which is a known risk factor for tendinopathy/rotator cuff and low back,[32,38–42] could be another reason why disorders and pain were more prevalent among Employer 3 workers. Assembly line speed is also known to be directly proportional to worker injury in the manufacturing sector and food processing industry in particular.[43,44] In addition to higher volume of repetitive work, faster line speeds may increase risk of musculoskeletal disorders and pain in other ways. For example, workers may not be able to take the time to sharpen knives as frequently, resulting in more force needed to accomplish cutting tasks. Mental and physical fatigue could lead to poor posture and technique, which can increase stress on the upper body. Workspace differences could also explain disorders and pain risk, as manual labor within confined areas is associated with musculoskeletal disorders and pain.[37] Workers positioned closely to each other may not be able to assume positions that create the best leverage for cutting or lifting.

Only 11.8% of participants at Employer 3 had worked in poultry processing for more than 4 years, and none had worked 10 years or more. This might be the result of turnover as employees leave due to injury or bad working conditions. Higher worker turnover at a given plant could increase risk of overuse injury, as less experienced workers may not know optimum techniques and precautions, and lower numbers of experienced workers are available to teach and model these proper behaviors. Employer approach to training of new workers can also influence how likely workers are to use proper techniques and safety precautions.

It is also possible that unmeasured cultural factors play a role in the within-company similarities of workers. It is well established in international migration that individuals often follow others from the same region to a new worksite.[45] To the extent that such individuals share beliefs

and practices related to work, health, and symptom recognition, they may exhibit similar illness and injury patterns.

Findings of this study should be taken in light of its limitations. The study is cross-sectional, so no temporal relationships among work, symptoms, and epicondylitis, rotator cuff syndrome, and lower back pain can be established. The generalizability of the findings is limited, as the workers were recruited from one area in the United States. The sample is not a population-based random sample, as this is a hard-to-reach population, and community-based sampling was used. Even though participants were assured that the information they provided would be anonymous, some eligible workers might have declined participation for fear of retaliation. Lastly, the categorization of task within poultry work is not precise; some workers have multiple tasks along the production line, but workers were classified under one task if that task was performed more than 50% of the time.

Nonetheless, this study provides important findings of injury rates in a hard-to-reach worker population. The results of this study are especially relevant because the US Department of Agriculture is moving forward a proposal to privatize line inspections, allowing poultry processing companies to increase speed lines without accounting for the safety and health of poultry processing employees.[46] Through this proposal poultry processing companies would be entirely responsible for conducting inspection of chicken carcasses for disease. Since the companies will provide the inspectors, they argue that it is feasible to increase line speeds. If this change takes place, the risk of having a musculoskeletal disorder and pain is likely to increase due to increasing line speeds, ignoring the health and safety of the workers. Future research should assess how other factors, such as working hours, line speed, and workspace differences among employers, correlate with musculoskeletal disorders and pain of poultry processing workers. Since access to worksites is often limited, a possible way to access some of the worksite factors is to use methods such as those used by Lipscomb et al. where an industry-specific job exposure matrix was constructed using general knowledge of the industry combined with the information provided by the poultry processing workers.[14] Policy changes such as standardized line speed that take into account the safety of the workers, and proper reporting of injuries should be implemented to prevent injuries.

## *Conclusion*

Poultry processing is an industry that has high injury rates. Mechanization and vertical integration have contributed to the high injury rates among poultry processing workers. Since access to the industry to conduct occupational health research is limited, our study team through community-based sampling sought to gain knowledge on possible factors associated with prevalent musculoskeletal disorders and pain. The results of our study showed that employer is a predictor of musculoskeletal disorders and pain. These results contribute to the limited literature on immigrant Latino processing workers because they could serve as precedence for further research examining possible causes of injury in greater detail.

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