The Prevalence of Carpal Tunnel Syndrome in Latino Poultry-Processing Workers and Other Latino Manual Workers

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Objective: To determine the prevalence of carpal tunnel syndrome (CTS) in Latino poultry-processing workers. **Methods:** Symptoms and nerve conduction studies were used to prospectively assess 287 Latino poultry-processing workers and 226 Latinos in other manual-labor occupations. **Results:** The prevalence of CTS was higher in poultry-processing (8.7%) compared with nonpoultry manual workers (4.0%; $P < 0.0001$). The adjusted odds ratio for the prevalence of CTS in poultry workers was 2.51 (95% confidence interval, 1.80–3.50) compared with nonpoultry workers. Within the poultry workers, those who performed packing, sanitation, and chilling had a trend toward less CTS than those who performed tasks requiring more repetitive and strenuous hand movements. **Discussion:** Latino poultry-processing workers have a high prevalence of CTS, which likely results from the repetitive and strenuous nature of the work.

Carpal tunnel syndrome (CTS) is a common condition with an estimated prevalence in the general population of 2.7% and health care costs in the United States exceeding $500 million per year.[1,2] Typical symptoms include numbness, tingling, and pain in the palmar and lateral aspects of the hand; and weakness of hand muscles may occur as the condition progresses. It is thought to result from chronic compression of the median nerve as it passes through the rigid carpal tunnel in the wrist.[3] Therefore, those who perform manual labor involving repetitive wrist movement are at increased risk for the development of CTS, with reported prevalence of 7.8% in occupations involving assembly lines, such as slaughterhouse workers.[4] Carpal tunnel syndrome is a leading cause of workers' compensation claims and results in significant lost time and productivity among manual workers.[5]

Poultry processing involves strenuous and repetitive work, with workers at risk for overuse injuries.[6,7] Live birds are received and then passed through a production line that requires workers to hang, kill, pluck, clean, eviscerate, cut, package, and box poultry parts at a rapid pace, and workers also clean and repair equipment, assemble boxes, and move pallets of packaged poultry.[8,9] Potential risk for overuse injuries such as CTS exists with each of these occupational duties.

Across the United States, the poultry-processing workforce has become largely composed of immigrants, with Latinos making up a large proportion.[6,10] This group bears a disproportionate burden of workplace injury because of language and cultural barriers that prevent workers from receiving health and safety measures, as well as reluctance of workers to complain about work conditions.[11–13] Therefore, this study was conducted to examine the prevalence of CTS in Latino poultry-processing workers and to compare this prevalence with Latinos in other manual-labor positions. In addition, it was designed to assess characteristics that may increase the risk of CTS in poultry-processing workers.

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METHODS

Participants

Latinos in poultry and nonpoultry manual-labor occupations were recruited in four western North Carolina counties from June 2009 to November 2010 to participate in a study assessing musculoskeletal, dermatologic, and respiratory conditions in these populations. Since there was no access to workplaces, community-based sampling of dwelling units was performed with a focus on regions with a high proportion of Latino residents. Only those who were self-identified as Latino or Hispanic, were aged 18 years or older, and who worked 35 hours or more per week in a manual-labor job were recruited. Work in poultry was defined as any type of nonsupervisory work in a poultry-processing plant with job categories from receiving through sanitation, and employees of poultry production farms were excluded. Manual-labor jobs were defined as employment in nonmanagerial jobs in industries such as landscaping, construction, restaurant work, hotel work, child care, and manufacturing. Nonpoultry workers with previous work in poultry qualified only if lifetime employment in poultry-processing was 6 months or less and not within the past 2 years. More than one resident per dwelling could be recruited, if eligible. Those who chose to enroll in the study underwent an hour-long interview and then attended a data collection clinic. The data collection clinics occurred on seven Sundays evenly dispersed throughout the study period. All participants signed informed consent, and the study was approved by the institutional review board of Wake Forest School of Medicine. Each participant was paid $40 for participating in the data collection clinic.

Over the course of the study, 1526 individuals were screened and 957 were eligible for enrollment. Of those, 742 underwent interviews and 518 attended the data collection clinics. Five individuals left the data collection clinics prior to undergoing nerve conduction studies, which resulted in 513 who had nerve conduction studies and filled out hand diagrams (1026 wrists). Of those, 287 (574 wrists) were poultry workers and 226 (452 wrists) were in those who did nonpoultry manual labor.

Clinical Evaluations

Each participant's height and weight were recorded. They were asked whether they had numbness, pain, or weakness in their hands for two or more days in the previous month. If they answered affirmatively, they completed the Katz hand diagram to indicate distribution of symptoms. The hand diagrams were scored "unlikely" (0), "possible" (1), "probable" (2), or "classic" (3) for CTS on the basis of previously published methods for scoring of the diagram, and each

diagram was scored by two clinicians (M.S.C. and F.O.W.) blinded to the participant's occupation and nerve conduction results.[14]

Nerve Conduction Studies

All study participants underwent bilateral nerve conduction studies by using a Teca TD10 Electromyograph (Teca Corporation, Pleasantville, NY). The studies were performed by experienced technicians blinded to the participant's occupation and clinical evaluations. Hands were warmed to 32°C, and median and ulnar antidromic sensory studies were performed, stimulating the wrist and recording with ring electrodes 140 mm distally on the second and fifth fingers. The onset and peak latencies were recorded, and those without median sensory potentials underwent orthodromic median motor studies recording from the abductor pollicis brevis muscle.

Measures

A combination of symptoms, as reported through the Katz hand diagram, and nerve conduction abnormalities was used to define CTS. If the hand diagram was scored a 1, 2, or 3, then the participant was assigned a score of "1" for symptoms; if not, the participant was assigned a "0." Peak median and ulnar sensory latencies were compared. If the median was less than 0.49 ms longer than the ulnar, it was scored a "0"; if it was 0.50 to 0.79 ms longer, it was scored a "1"; and if it was greater than 0.80 ms longer, it was scored a "2." The symptom score and nerve conduction score were then added and a total score of 0 was defined as "no CTS," 1 to 2 as "possible CTS," and 3 as "CTS." Similar CTS case definitions, with 0.50 ms and 0.80 ms cutoffs for peak latency difference, have been used in previous studies.[15] This scoring system was applied to each wrist that was studied. In addition, individuals were defined as having "no CTS" if both wrists were scored as "0," "possible CTS" if one or both wrists were scored a "1 or 2," and "CTS" if either wrist was scored a "3."

Poultry-processing workers underwent standardized interviews regarding their work schedule and environment. Workers were asked to identify which of the following tasks they performed: cutting; eviscerating; washing; trimming; deboning; receiving; hanging; killing; plucking; packing; sanitation; chilling; and other. Those who performed a single task more than 50% of the time were categorized into that task for statistical analyses, and those who performed multiple duties and no single task occupied more than 50% of their time were categorized into "multiple tasks." Many of the tasks were similar in nature, so to assist in analysis, four groups were created to determine whether similar tasks increased the risk of CTS. The groups included packing, sanitation, chilling, and other (category 1); cutting, eviscerating, wash-up, trimming, and deboning (category 2); receiving, hanging, killing, and plucking (category 3); and multiple jobs (category 4).

Statistical Analyses

Descriptive statistics were calculated as means and standard deviations for continuous variables and percentages and frequencies for discrete variables. Demographics between the poultry and nonpoultry groups were compared by using Student *t* tests for continuous variables and chi-square tests of association for categorical variables. The prevalence of CTS was compared among the two groups by using a chi-square test of association, and this was done at the level of individual wrists and participants. Adjusted odds ratios and 95% confidence intervals (CIs) predicting the prevalence of CTS were calculated by using ordinal logistic regression and adjusting for age, body mass index (BMI), sex, occupation, and clustering between individuals. In poultry workers, variables were analyzed to determine whether they predicted the prevalence of CTS by calculating *P* values using ordinal logistic regression for continuous variables and chi-square tests of association for categorical variables, and this was done at the wrist level. Similar occupational duties were grouped together for analysis, as described previously in the Measures section. The score test for the proportional odds assumption was used to validate all models. All *P* values were considered significant at the 0.05 level, and statistical calculations were performed by using SAS Version 9.2 (SAS Inc, Cary, NC).

RESULTS

The demographic characteristics for the poultry-processing workers and nonpoultry workers are described in Table 1. Poultry workers were older than nonpoultry workers (36.3 vs 32.7 years; $P \leq 0.0001$). The poultry group also weighed less and had a trend toward being shorter, which resulted in similar BMIs between the groups (28.6 in poultry and 29.2 in nonpoultry; $P = 0.1739$). The groups were similar in the percentage of women and the distribution of spoken languages, and the poultry workers had less formal education ($P = 0.0354$).

The prevalence of CTS was higher in the poultry workers than the nonpoultry workers ($P < 0.0001$), and this held true when the prevalence was evaluated by considering either the wrist or the worker as an individual unit for statistical analysis (Table 2). When wrists were assessed, 6.5% of the poultry worker wrists had definite CTS compared with 2.4% for nonpoultry, and 48.0% of the poultry worker wrists had possible or definite CTS compared with 26.3% of nonpoultry worker wrists. When individuals were assessed, 8.7% of the poultry workers had definite CTS compared with 4.0% of the nonpoultry group, and 59.2% of the poultry workers had possible or definite CTS compared with 35.0% of nonpoultry workers. The adjusted odds ratio (controlling for age, BMI, and sex) for the prevalence of CTS was 2.51 (95% CI, 1.80–3.50) in poultry workers compared with nonpoultry workers (Table 3). Table 3 also showed the increased risk of CTS with increasing age (odds ratio of 1.04; 95% CI, 1.02–1.06) and BMI (odds ratio of 1.08; 95% CI, 1.05–1.12) and that sex was not associated with an increased risk of CTS.

In the 287 poultry workers (574 wrists), greater age was seen in those with CTS compared with those with possible or no CTS (Table 4). Table 4 also shows that job category predicted the prevalence of CTS, with those in category 1 (packing, sanitation, chilling, and other) having less CTS than those in category 4 (multiple jobs) and a trend toward less than those in category 2 (cutting, eviscerating, wash-up, trimming, and deboning). Comparisons of CTS prevalence in job categories 2, 3, and 4 with each other did not approach statistical significance.

DISCUSSION

In this study, multiple analyses were performed, at the level of both the wrist and the individual, and the prevalence of CTS was consistently higher in Latino poultry-processing workers compared with other Latino manual workers. The prevalence of CTS in the nonpoultry manual workers (2.4% of wrists and 4.0% of individuals) was similar to the prevalence in the general population found in previous studies,[1] whereas the odds of CTS was more than 2.5 times greater in the poultry-processing workers. It is unlikely that factors other than occupational tasks accounted for the difference in CTS prevalence, as the two groups were similar in BMI and sex distribution and the poultry workers were actually younger in age (older age is associated with an increased risk of CTS). Therefore, the repetitive and strenuous nature of poultry-processing work likely resulted in the increased CTS prevalence. This is supported by the finding that poultry workers who performed tasks requiring the most repetitive hand manipulation (cutting, eviscerating, washing, trimming, deboning, and multiple tasks) had more, or a trend toward more, CTS than those performing other tasks along the production line (packing, sanitation, chilling, and other).

The actual prevalence of CTS in the poultry workers depends on the parameters used to define CTS. The most sensitive combination of symptoms and nerve conduction studies results in 48% of

TABLE 1. Demographic Characteristics in the Poultry and Nonpoultry Laborers

Characteristic	All Laborers Mean (SD) or No. (Column %)	Poultry Mean (SD) or No. (Column %)	Nonpoultry Mean (SD) or No. (Column %)	*P*
Age	34.7 (10.4)	36.3 (11.2)	32.7 (9.1)	<0.0001
Height (cm)	157.7 (8.4)	157.2 (8.3)	158.4 (8.6)	0.0934
Weight (kg)	71.9 (13.6)	70.8 (12.9)	73.3 (14.3)	0.0344
Body mass index	28.9 (4.9)	28.6 (4.5)	29.2 (5.3)	0.1739
Sex				0.6591
Male	278 (54.2)	158 (55.0)	120 (53.1)	
Female	235 (45.8)	129 (45.0)	106 (46.9)	
Spoken language				0.2858
Indigenous	106 (20.8)	64 (22.5)	42 (18.7)	
Nonindigenous	403 (79.2)	220 (77.5)	183 (81.3)	
Education, yrs				0.0354
0–6	298 (58.1)	181 (63.1)	117 (51.8)	
7–9	120 (23.4)	60 (20.9)	60 (26.5)	
≥10	95 (18.5)	46 (16.0)	49 (21.7)	

TABLE 2. The Prevalence of Carpal Tunnel Syndrome in Poultry and Nonpoultry Laborers

	Overall No. (Column %)	Poultry No. (Column %)	Nonpoultry No. (Column %)	*P*
By wrists ($N = 1026$)				<0.0001
No carpal tunnel syndrome	632 (61.6)	299 (52.1)	333 (73.7)	
Possible carpal tunnel syndrome	346 (33.7)	238 (41.5)	108 (23.9)	
Definite carpal tunnel syndrome	48 (4.7)	37 (6.5)	11 (2.4)	
By individuals ($N = 513$)				<0.0001
No carpal tunnel syndrome	264 (51.5)	117 (40.8)	147 (65.0)	
Possible carpal tunnel syndrome	215 (41.9)	145 (50.5)	70 (31.0)	
Definite carpal tunnel syndrome	34 (6.6)	25 (8.7)	9 (4.0)	

TABLE 3. Adjusted Odds Ratios for the Prevalence of Carpal Tunnel Syndrome ($N = 1026$ Wrists)

Characteristic	Adjusted Odds Ratio	95% Confidence Interval	*P*
Type of work			<0.0001
Poultry	2.51	1.80–3.50	
Nonpoultry	—	—	
Age	1.04	1.02–1.06	<0.0001
Body mass index	1.08	1.05–1.12	0.0001
Sex			0.8733
Female	1.03	0.74–1.43	
Male	—	—	

the wrists and 59.2% of the individuals categorized as possible or definite CTS, whereas the most specific combination of parameters results in 6.5% of the wrists and 8.7% of the individuals categorized as definite CTS. The true prevalence certainly lies somewhere between these values, but no matter which definition is used, it is clear that the prevalence of CTS is high in this population.

Some limitations exist in this study. First, defining CTS in a large population such as this can be challenging because it is not feasible to obtain a detailed history, physical examination, and electrodiagnostic study on each participant. We opted to use a combination of self-reported symptoms and sensory nerve conduction studies to assess for CTS. While this is less thorough than the evaluation performed by a meticulous clinician on an individual patient, it is at least as complete as other studies in which large populations were screened for CTS.[4,16,17] The second limitation occurred when trying to categorize poultry workers by tasks, as many workers performed multiple tasks along the production line on a weekly basis. It was decided that workers would only be categorized to a task if they performed it more than 50% of the time; otherwise, they were placed into the "multiple tasks" category. This strategy allowed most workers to be categorized, but many participants performed tasks on a weekly basis other than the one to which they were grouped. For this reason, it is challenging to identify very specific tasks associated with a higher prevalence of CTS. While these limitations are present, they are relatively minor, and the strengths of the study, including a large sample size, relevant comparison group, and systematic approach to CTS diagnosis, outweigh the limitations.

CONCLUSION

The high prevalence of CTS in this population indicates that measures should to be taken to reduce the amount of repetitive strain on the hands and wrists of poultry-processing workers and to increase early identification of CTS. Since some poultry-processing tasks (such as packing, sanitation, and chilling) were associated

TABLE 4. Characteristics Potentially Associated with Carpal Tunnel Syndrome in Poultry Workers ($N = 574$ Wrists)

Characteristic	No Carpal Tunnel Syndrome Mean (SD) or No. (Row %)	Possible Carpal Tunnel Syndrome Mean (SD) or No. (Row %)	Carpal Tunnel Syndrome Mean (SD) or No. (Row %)	Multivariate Analysis	
				Adjusted Odds Ratio	*P*
Age	34.4 (11.0)	38.2 (10.7)	40.1 (12.1)	1.04	0.0008
Body mass index	28.1 (4.4)	29.0 (4.4)	30.3 (5.5)	1.04	0.0842
Sex					
Female	131 (50.8)	108 (41.9)	19 (7.4)	1.09	0.7045
Male*	168 (53.2)	130 (41.1)	18 (5.7)	—	—
Poultry job task†					0.0283, $df = 3$
Category 1*	123 (58.6)	75 (35.7)	12 (5.7)	—	—
Category 2	129 (50.4)	115 (44.9)	12 (4.7)	1.57	0.0661
Category 3	21 (47.7)	16 (36.4)	7 (15.9)	2.09	0.1156
Category 4	26 (40.6)	50 (50.0)	6 (9.4)	2.66	0.0035

*Reference category.

†Category 1: packing, sanitation, chilling, and other; category 2: cutting, eviscerating, wash-up, trimming, and deboning; category 3: receiving, hanging, killing, and plucking; category 4: multiple job tasks.

with less CTS, one consideration would be for all workers to rotate through these tasks on regular intervals. Other interventions, such as an emphasis on ergonomics, should also be considered, although the data supporting this type of intervention are limited.[18] Finally, increased surveillance for the development of CTS in this population could result in earlier identification and treatment.[19]

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