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The Coexistence of Carpal Tunnel Syndrome in Workers With Trigger Digit

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Abstract

Background: The objective of this study was to investigate the prevalence of carpal tunnel syndrome (CTS) in workers with trigger digit. There are few cross-sectional studies that assess this relationship. **Methods:** A baseline examination of 1216 workers from 17 diverse manufacturing facilities was conducted. Worker demographics, medical history, and symptoms of trigger digit were assessed. Age, sex, and body mass index were obtained. Biomechanical factors were individually measured using the Strain Index (SI). Prevalence was assessed with univariate and multivariate logistic regression. **Results:** Unadjusted prevalence of trigger digit was 12.0%, and among those workers, there was an unadjusted CTS prevalence of 26.7%. The adjusted multivariate model found an odds ratio (OR) of CTS of 1.56 (95% confidence interval [CI], 1.03-2.36) among the workers with trigger digit. The ORs of CTS for SI (OR = 1.53 [95% CI, 1.04-2.23]), age (OR = 1.03 [95% CI, 1.01-1.04]), and current smoking (OR = 1.76 [95% CI, 1.12-2.75]) were also significant. Sex and diabetes were not statistically significant covariates. **Conclusion:** The prevalence of CTS is higher among workers with trigger digit.

Keywords: carpal tunnel syndrome, nerve, diagnosis, biomechanics, basic science, finger, fracture/dislocation, epidemiology, research and health outcomes, hand, anatomy, digits

Introduction

Carpal tunnel syndrome (CTS) is the most common peripheral entrapment neuropathy and is costly, resulting in approximately $2 billion in US annual medical costs.[1] Nonmedical costs are high as well, with lost work time averaging 28 days, second only to 31 days for fractures.[2] The prevalence of CTS has been estimated to be 2% to 5% in the general population.[3,4] Pooled analyses from 6 prospective occupational studies showed a prevalence of CTS of 7.8%.[5] Reported nonoccupational risk factors for CTS commonly include: female sex, age, obesity, rheumatoid arthritis, thyroid disorders, and diabetes mellitus.[6-9]

Trigger digit, also known as flexor tendon entrapment of the digits, is another common upper extremity musculoskeletal disorder (MSD). Trigger digit is generally more common among women than men and usually affects individuals in their fifth or sixth decades.[10] There is a reported prevalence of 2.6% for trigger digit among nondiabetic adults older than 30 years.[11] Trigger digit is 8 times more common among those with diabetes compared with those without.[12] Higher prevalence rates have been reported among workers; for example, Gorsche et al[13] reported a point prevalence of 14% among meat-packing plant workers. Although there are limited studies evaluating causal factors for trigger digit, past studies have suggested risk factors similar to those for CTS, and these include both systemic and biomechanical factors.[14]

Prior studies have shown CTS and trigger digit to be statistically associated. When Phalen[15] reviewed his case series of 384 patients with CTS, he reported that 32 (8.3%) also had trigger finger or trigger thumb, and it was the third most common association after diabetes mellitus and rheumatoid arthritis. Of the 32 participants, 28 (87.5%) were women. Among a case series of 511 patients from an upper extremity clinic, 211 (41.3%) had trigger digit, and of those 211, 91 (43.1%) also had CTS.[16] A retrospective cohort found the overall risk of trigger digit(s) to be 3.63-fold

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greater among those having had carpal tunnel release.[17] Understanding these interrelationships may better inform the etiology of these 2 seemingly disparate MSDs.

This study's hypothesis is that there is a statistically significant relationship between trigger digit and CTS, resulting in a higher prevalence of CTS in a working population with trigger digit compared with those without trigger digit after adjustment for potential confounders. Quantification of this relationship in a defined population would provide a higher level of evidence and an improved quantification of association than the prior case series, as well as be more generalizable than a population that is postsurgical.

Methods

This study's workers come from baseline analyses of the WISconsin-uTAH (WISTAH) prospective cohort study. The WISTAH study is a multicenter investigation of upper extremity MSDs, with workers enrolled from 3 states (Illinois, Utah, and Wisconsin). The WISTAH study was approved by the University of Wisconsin–Milwaukee (#03.02.059) and University of Utah (#11889) institutional review boards. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all workers included in the study. Details of the WISTAH study and data collection methods were previously published; thus, brief methods follow.[18]

Cross-sectional data from baseline examinations were analyzed. A total of 1216 workers were enrolled from various jobs mostly in the manufacturing sector. A Health Outcomes Assessment Team administered a baseline laptop-administered questionnaire, computerized structured interview, 2 standardized physical examinations, and a nerve conduction study and measured biometrics (eg, height, weight, blood pressure). A trained Job Exposure Assessment Team separately observed, videotaped, and measured each worker's job(s) to quantify individualized biomechanical factors.[19]

The questionnaires included age, sex, diabetes mellitus, rheumatoid arthritis, hand osteoarthrosis, hypertensive history, thyroid disorder, pregnancy, smoking status, and psychosocial factors (eg, feelings of depression). Structured interviews included diagnostically relevant information such as symptoms of disorders, past MSDs (eg, trigger digit, CTS), and treatments for disorders. Structured interviews included pain, location of pain, current locking, and distribution of tingling and numbness. Physical examinations included Heberden nodes and trigger digit findings (locking, tendon nodule, and tenderness over the A1 pulley). All workers underwent complete structured physical examinations irrespective of symptoms or disorders.

The case definition for trigger digit was: (1) a history of locking with active flexion, passive flexion, or extension of the affected digit; (2) palpable nodule of the affected digit; and/or (3) examination evidence of locking on active or passive flexion of the affected digit. A worker with examination evidence of triggering but who had not sought clinical care for triggering was included as having trigger digit. Those workers with a prior history of trigger digit who required treatment and those meeting the case definition of trigger digit at baseline were included as cases in this study.

For CTS, the case definition was a history of tingling and/or numbness in at least 2 median nerve–served digits (thumb, index, middle, and ring fingers) plus an abnormal nerve conduction study consistent with CTS. For purposes of this study, those who had a history of surgical release, those who underwent treatment with a glucocorticosteroid injection for CTS, and/or those who had current evidence of CTS were considered a CTS case.

Biomechanical factors were quantified and videotapes were analyzed to develop a Strain Index (SI) score for each worker.[18] The SI is a validated semiquantitative ergonomic tool.[20,21] The SI is based on a rating of 6 factors: intensity of exertion, duration of exertion, efforts per minute, hand/wrist posture, speed of work, and duration of task per day.

Statistical Analyses

These analyses were performed using SAS (Cary, NC) 9.4 An individual was only counted once even if he or she had bilateral CTS or multiple fingers with triggering. The descriptive statistics were calculated for the cases and covariates. We identified the workers with and without trigger digit and compared the prevalence of CTS in each of those populations for unadjusted prevalence measures. We then conducted univariate analyses for trigger digit and each covariate. Multivariate models were built to test whether the trigger digit was associated with increased prevalence of CTS after controlling for covariates. A single initial multivariate model was built using covariates that were not collinear and had a univariate value of $P \leq .15$. With these covariates, Akaike information criterion (AIC) was used to select a final covariate model using a best-subsets approach.

Results

There were a total of 1216 workers for whom data were collected. Of these, 140 workers had partially missing data and were excluded from adjusted analysis, but were included when data were available for unadjusted statistics. Six workers were removed as they were missing information about rheumatoid arthritis. The combined workforce (Table 1) comprised approximately a 2:1 female-to-male ratio. The unadjusted prevalence of trigger digit was similar in women

Table 1. Descriptive Statistics for Trigger Digit, CTS, and Covariates.

Category	Variable	Category	Mean ± SD or No. (%)	Trigger digit	CTS	Both	Neither
Demographics	Age		42.2 ± 11.4	44.7 ± 11.3	45.3 ± 9.7	46.0 ± 10.9	42.1 ± 11.4
	Sex	Male	412 (33.9)	50 (12.1)	47 (11.4)	10 (2.4)	325 (78.9)
		Female	804 (66.1)	96 (11.9)	188 (23.4)	29 (3.6)	549 (68.3)
Anthropometric	BMI, kg/m^2		29.5 ± 6.9	30.0 ± 6.5	31.6 ± 7.5	32.0 ± 7.9	29.4 ± 6.9
Medical conditions	Trigger digit	Yes	146 (12.0)		39 (26.7)	39 (26.7)	
	CTS	Yes	235 (21.8)	39 (16.5)		39 (16.5)	
	Diabetes mellitus	Yes	64 (5.3)	7 (10.9)	25 (39.1)	3 (4.7)	35 (54.7)
	Rheumatoid arthritis	Yes	11 (0.9)	3 (27.3)	2 (18.2)	0 (0)	6 (54.6)
	Osteoarthrosis	Yes	111 (9.1)	15 (13.5)	32 (28.8)	7 (6.3)	71 (64.0)
	Dupuytren contracture	Yes	5 (0.4)	2 (40)	2 (40)	1 (20)	2 (40)
	Pregnancy	Yes	10 (0.8)	1 (10)	0 (0)	0 (0)	9 (90)
	Thyroid disorder	Yes	83 (6.8)	9 (10.8)	28 (33.7)	5 (6.0)	51 (61.4)
	History of hypertension	Yes	202 (16.6)	25 (12.4)	56 (27.7)	8 (4.0)	129 (63.9)
Social history	Smoking	Current	334 (27.5)	45 (13.5)	59 (17.7)	10 (3.0)	240 (71.9)
		Never	584 (48)	56 (9.6)	113 (21.9)	13 (2.2)	428 (73.3)
		Past	298 (24.5)	45 (15.1)	63 (24.0)	16 (5.4)	206 (69.1)
Job physical factors	Strain Index	≤6	653 (60.7)	68 (10.4)	132 (20.2)	20 (3.1)	473 (72.4)
		>6.0	488 (39.3)	59 (12.1)	103 (21.1)	19 (3.9)	345 (70.7)
			Median 6 M 8.7 (SD 10.3)				

Note. CTS = carpal tunnel syndrome; BMI = body mass index; SD = standard deviation.

and men (11.9 % vs 12.1%, respectively). In contrast, women had more than twice the prevalence of CTS (23.4%) than men (11.4%). The average age was 42.2 ± 11.4 years. The mean body mass index was 29.5 kg/m^2.

There were 146 workers with trigger digit, which was a prevalence of 12.0%. Among those 146 workers, 39 (26.7%) also had evidence of CTS. After excluding those workers with incomplete data, there were 127 workers (87.0%) with trigger digit who were included in further analyses.

The most common medical condition among workers was CTS (21.8%). Of those with CTS, there were 39 (16.5%) with trigger digit. Trigger digit was also more common in workers with rheumatoid arthritis and Dupuytren contracture, although it should be noted that Dupuytren contracture is an uncommon condition, comprising only 5 (0.4%) workers. Workers with osteoarthrosis, Dupuytren contracture, a history of smoking, and/or thyroid disorder had 5% or higher prevalence of CTS and trigger digit comorbidity.

When evaluating modifiable covariates, approximately half of the workers either currently smoke (27.5%) or previously smoked (24.5%). The prevalence of trigger digit was higher in smokers, with 13.5% among current smokers and 15.1% among past smokers, compared with 9.6% among nonsmokers. When analyzing the job physical factors, the median SI score was 6 with a mean of 8.7 ± 10.3. The prevalence of trigger digit among those with a high SI score was 12.1%, which was not statistically significantly higher than the prevalence among those with a low SI score (10.4%).

The univariate odds ratio (OR) for the relationship between CTS and trigger digit was 1.70 (95% confidence interval [CI], 1.13-2.56). This was the second highest association with CTS among all covariates, behind only rheumatoid arthritis (Table 2). The other statistically significant covariates with trigger digit were age (OR = 1.02 [95% CI, 1.01-1.03]), current smoking (OR = 1.60 [95% CI, 1.03-2.5]), and past smoking (OR = 1.59 [95% CI, 1.01-2.5]). No other factors reached statistical significance. Trends toward significance were found for both rheumatoid arthritis (OR = 3.78 [95% CI, 0.93-15.30]) and high SI (OR = 1.40 [95% CI, 0.96-2.02]). Female sex (OR = 0.86 [95% CI, 0.60-1.37]) and history of diabetes (OR = 0.82 [95% CI, 0.42-1.89]) showed no association with trigger digit.

A multivariate model of trigger digit included variables with a value of $P \leq .15$ (CTS, age, smoking status, rheumatoid arthritis, and SI). None of the variables showed collinearity with each other using the Spearman correlation. The model with the lowest AIC value included CTS, age, smoking status, and SI. With this model (Table 3), precision improved, although overall the variables maintained ORs similar to those from the univariate analyses.

Discussion

Among workers with trigger digit, the prevalence of CTS was increased by 56%. Unadjusted prevalence of CTS among workers was above 2-fold; with univariate and multivariate regression, the odds increased 70% and 50%, respectively.

Table 2. Univariate Analyses for Trigger Digit and Each Covariate.

Variable	OR	95% CI	*P* value
CTS			
Yes vs no	**1.70**	**1.13-2.56**	.01
Age	**1.02**	**1.01-1.03**	.01
Smoking			
Never	1.00	Reference	
Current	**1.60**	**1.03-2.48**	.04
Past	**1.59**	**1.01-2.52**	0.05
Rheumatoid arthritis			
Yes vs no	3.78	0.93-15.30	.06
Strain Index			
0-6	1.00	Reference	.08
>6.0	1.40	0.96-2.02	
Osteoarthrosis			
Yes vs no	1.34	0.75-2.41	.32
Sex			
F vs M	0.86	0.60-1.37	.54
BMI	1.01	0.98-1.34	.56
Diabetes mellitus			
Yes vs no	0.82	0.35-1.95	.66
Thyroid disorder			
Yes vs no	0.89	0.42-1.89	.75
Pregnancy			
Yes vs no	0.82	0.10-6.58	.86
History of hypertension			
Yes vs no	1.00	0.61-1.62	.97

Note. OR = odds ratio; CI = confidence interval; CTS = carpal tunnel syndrome; BMI = body mass index.
Bold values are statistically significant.

Table 3. Multivariate Analyses for Trigger Digit and Each Covariate.

Variable	OR	95% CI	*P* value
CTS			
Yes vs no	**1.56**	**1.03-2.36**	.04
Age	**1.03**	**1.01-1.04**	.01
Smoking			
Never	1.00	Reference	
Current	**1.76**	**1.12-2.75**	.01
Past	1.56	0.98-2.47	.06
Rheumatoid arthritis			
Yes vs no	2.85	0.68-11.84	.15
Strain Index			
0 to 6	1.00	Reference	
>6.0	**1.53**	**1.04-2.23**	.03
Osteoarthrosis			
Yes vs no	1.10	0.60-2.02	.75
Sex			
F vs M	0.79	0.53-1.19	.26
BMI	1.01	0.98-1.04	.53
Diabetes mellitus			
Yes vs no	0.65	0.27-1.59	.35
Thyroid disorder			
Yes vs no	0.71	0.33-1.54	.38
Pregnancy			
Yes vs no	2.50	0.28-22.11	.41
History of hypertension			
Yes vs no	0.78	0.46-1.30	.34

Note. OR = odds ratio; CI = confidence interval; CTS = carpal tunnel syndrome; BMI = body mass index.
Bold values are statistically significant.

Cigarette smoking and age were also statistically significantly associated with CTS.

The prevalence of trigger digit was much higher in this working population than in the general public and more closely matched the prevalence reported by Gorsche et al[13] in meat-packing plant workers. In the general population, trigger digit is not a common condition with a reported prevalence of less than 3%.[11] Compared with Phalen's[15] case series, this study found approximately double the prevalence of trigger digit in the population of those with CTS—16.5% to 8.3%. In contrast to the case series from hand surgery clinics, diabetes mellitus and sex were not statistically associated with trigger digit. However, there may be a healthy worker bias within this population. Diabetes mellitus was likely significantly underpowered in this study as this study included younger workers and likely includes fewer workers with the more severe cases of diabetes. These results suggest higher biomechanical forces as represented by the SI in the working population play a role in trigger digit.

Previous analyses of a subset cohort of WISTAH surprisingly did not find an association between CTS at baseline and increased incidence of trigger digit.[14] This could suggest a causal pathway whereby trigger digit increases risk of CTS but not vice versa. That subset cohort similarly showed a higher risk of trigger digit with an increase in SI. In contrast to the current study, the prior study reported a higher incidence of trigger digit in women and those with diabetes. Healthy worker survivor effect might explain the absence of these risk factors in the current study if those who develop troublesome trigger digit and/or develop substantially comorbidities tend to leave employment.

Strengths of this study include the initial systematic protocol for baseline assessments. The WISTAH study which developed intensive methods of analyzing this population of workers may have found higher rates of trigger digit than would otherwise be found. This study went beyond what would be captured in a clinic setting. The study was conducted across 3 states at 17 different, mostly manufacturing, employment sites. This should better reflect the manufacturing working population than if the sample was limited to a single state or a few employment sites.

Limitations of this study include the overall sample size. While study of several factors was possible in this population, the sample size was likely underpowered to measure known confounders, such as rheumatoid arthritis, pregnancy, and Dupuytren contracture, that relatively infrequently occur. A conscientious decision was made to consider for an individual only one case even if he or she had bilateral CTS or multiple trigger digits. Studies have shown individuals often have bilateral CTS or multiple trigger digits.[12] This may have led to underestimation of diabetes as possible factors on a population basis. On the contrary, the approach may help reduce the impact of individuals who would skew the data toward those factors on a case basis. This cross-sectional study helps clarify an association between trigger digit and CTS, but cannot delineate whether one causes the other.

Conclusion

The burden of trigger digit appears considerably higher in this working population than in the general population. Among workers with trigger digit, there is an approximately 50% higher prevalence of CTS. Further studies to delineate the sequencing and combinations of risk factors for these 2 disorders may help to better illustrate the causal pathways that appear to exist between and among these disorders.

Authors' Note

The data collection across 3 states was conducted by a group of researchers: The WISTAH study team.

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Ethical Approval

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

Informed consent was obtained from all workers included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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