Title Page

Socioeconomic status associated with carpal tunnel syndrome: A retrospective nationwide 11-year population-based cohort study in South Korea

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Manuscript word count: 3515 words

Risk factors and socioeconomic status associated with carpal tunnel syndrome: A retrospective nationwide 11-year population-based cohort study in South Korea

Key Points

Question

What is the relationship between stratified socioeconomic status and the incidence of carpal tunnel syndrome (CTS)?

Findings

In this retrospective population-based cohort study that included 512,942 participants sampled from the Korean National Health Insurance System(KNHIS) database, the incidence rate and hazard ratios for CTS tended to increase with lower socioeconomic status.

Implications

Low socioeconomic status was identified as a risk factor for the incidence of CTS.

Abstract

Importance

There have only been a few large-scale studies that have included a risk factor analysis for CTS. No prior study has investigated the relationship between the occurrence of CTS and stratified socioeconomic status, which is closely related to a person's type of job.

Objective

To confirm the known risk factors for CTS and also to determine the correlation between stratified socioeconomic status and the occurrence of CTS.

Design

We conducted this study using a retrospective cohort model based on the combined databases of the Korean National Health Insurance System from 2003–2013, a database compiled using information from a national periodic health-screening program that is used for reimbursement claims.

Setting

The setting was a population-based retrospective cohort study.

Participants

First, we randomly sampled 514,795 patients who represented 10% of the 5,147,950 people who took part in periodic health screenings from 2002–2003. Existing CTS patients were excluded from this group. Therefore, this study finally included 512,942 participants and followed their medical records from 2003–2013.

Main Outcomes and Measures

Desired outcomes were the incidence rate of CTS and the hazard ratios according to stratified socioeconomic status.

Results

A correlation analysis showed that CTS was more likely to occur in patients from a lower socioeconomic status.

Conclusions and Relevance

CTS was associated with people of a lower socioeconomic status who work in simple but repetitive manual labor jobs. We believe that the results of our study will be helpful to determine the pathophysiology of CTS and to set up a new industrial health policy for this condition.

Key words: Carpal tunnel syndrome, Socioeconomic Status, Cohort Study, Korea

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common compressive neuropathy of the median nerve.¹⁻³ This condition is thought to be caused by the entrapment of the median nerve within the tendons of the hand in the carpal tunnel. Clinical features include tingling sensations, numbness and neuropathic pain over the median nerve distribution, and thenar muscle weakness and atrophy.³ The prevalence of CTS in the general population has been reported to be approximately 3.8–5.8%.^{1,4,5} The reason for this variation in the prevalence rate may be due to differences in diagnostic criteria, study designs and population.^{2,3,6} Although CTS has been studied extensively, its pathophysiology is still not fully understood.⁷ Several previous studies have revealed an association between various risk factors and CTS. For example, it is generally known to be common among middle-aged women.^{2,4} Other known risk factors are higher body mass index (BMI), diabetes mellitus (DM), rheumatoid arthritis (RA), gout, end-stage renal disease (ESRD), hypothyroidism, Raynaud's syndrome (RS), occupation, trigger finger, computer use, acromegaly, and excessive alcohol abuse and smoking.^{2,8-14}

The Korean health care system is based on the Korean National Health Insurance Service (KNHIS). Two independent institutions, the National Health Insurance Corporation (NHIC) and the Health Insurance Review and Assessment Service of Korea (HIRA), are the main offices that manage the medical insurance system. Both institutions compile data about health insurance operations and distribute them to researchers for study or to produce health policy. In South Korea, most people (97%) are required to enroll in the KNHIS.³ All medical institutions and facilities have mandatory contracts with the NHIC,¹⁵ which plays a main role in the qualification

of insurance payers and beneficiaries, the imposition of premiums and fine collection, maintenance of health insurance payers and beneficiaries, and the prevention of diseases by operating programs such as national periodic health screening. The HIRA is in charge of reviewing reimbursement claims from clinics and hospitals.¹⁵ These claims are accompanied by data including diagnostic codes, procedures, prescription drugs, personal information, hospital information, and the direct medical costs of both inpatient and outpatient care and dental services.¹⁵

We obtained 11-year follow-up cohort data of the NHIC and HIRA and aimed to verify the risk factors that impact the condition's occurrence and also to determine the correlation between stratified socioeconomic status and CTC prevalence.

Methods

Statement of Ethics

This study adhered to the tenets of the Declaration of Helsinki, and this research project was approved by the KNHIS (The research management number is NHIS-2017-2-536). This study design was reviewed and approved by the Institutional Review Board of our hospital. Written informed consent was waived.

Database

We used combined data from the national periodic health screening program database from 2002–2003 of the NHIC and the HIRA’s database of reimbursement claims from 2003–2013. The KNHIS and HIRA use the Korean Classification of Diseases (KCD) disease classification codes, which were modified from the International Classification of Diseases (ICD) codes.

Study Sample

We compiled an 11-year follow-up cohort model by randomly sampling participants from the database. Ten percent of the total population who received periodic health screening in 2002 and 2003 were sampled, which produced 514,795 out of 5,147,950 total participants (Fig. 1). Among these, people who had already been diagnosed with CTS were excluded. Therefore, we began our study with 512,942 participants who did not have CTS at the beginning of the year.

We defined CTS patients as those who had CTS codes as their main or secondary condition in the claims. We collected CTS patients who had the following diagnostic codes (KCD) based on data from the HIRA: carpal tunnel syndrome (G56.00), carpal tunnel syndrome in an unspecified upper limb (G56.01), carpal tunnel syndrome in the right upper limb (G56.02), or carpal tunnel syndrome in the left upper limb (G56.03).

Stratification of socioeconomic status by types of health insurance and amount of premium payment

Health insurance in South Korea is divided into three types: self-employed health insurance, employee health insurance and Medicaid. People with Medicaid pay a minimum or none of their medical bills, although there are some regulations and legal limits that govern their use of medical facilities. The premium payment of an employee is set by the standard based on his or her monthly salary. However, the self-employed insured premium payment is decided through a complex process that uses conversion points, which include the insurance payer's property, such as the value of houses and cars, economic activity by age and sex, and income reported to the Internal Revenue Service because self-employment income is difficult to exactly determine.

Health insurance premium payments are divided into 10 quantiles for each type of insurance, but we grouped the 10 quantiles into 4 groups; one group of the highest quantile and 3 groups categorized from the remaining nine quantiles (Table 1).

We refer to family members who are responsible for paying premiums as insurance payers, whereas beneficiaries are defined as family members whose insurance benefits are borne by the payers.

Validation of the known risk factors for carpal tunnel syndrome

The previously known risk factors were being female, being middle-aged, having a high BMI, smoking, and being diagnosed with hypertension (HTN), DM, RA, gout, ESRD, hypothyroidism, or RS. We validated the known risk factors for CTS by obtaining the incidence

rate of CTS in patients who had each risk factor as well as the hazard ratio (HR) of each risk factor that leads the disease to occur.

BMI was classified into five grades based on the Asian standard as follows: below 18.5 (underweight), 18.5–22.9 (normal), 23–24.9 (overweight), 25–29.9 (moderate obesity), and 30–35 (severe obesity). Participant smoking history was classified as non-smoker, ex-smoker or current smoker. We defined the presence of comorbidities as the following diagnostic codes in claims for medical services: DM (E.10, E.11, E.12, E.13, E.14), RA (M.05, M.06), gout (M.10), ESRD (N.18), hypothyroidism (E.031, E.032, E.038, E.039), and Raynaud’s syndrome (I.730).

Data analysis

We analyzed the demographic data according to type of insurance, premium payment amount grades and whether the participant was the insurance payer or a beneficiary.¹⁷ We also examined the occurrence rates of CTS according to various risk factors as well as hazard ratios that lead to CTS. In addition, we determined the correlation between socioeconomic status and CTS occurrence.

Statistical analysis

Descriptive statistics of the study populations were obtained, and Chi-square tests were performed to examine the association of risk factors with CTS. To identify any correlation between risk factors and CTS occurrence, adjusted hazard ratios (HRs) and 95% confidence

intervals (CI) were determined using a multivariate Cox proportional hazard regression. A significance level of 0.05 was set. The statistical package SAS for Windows, version 9.2 (SAS Inc., Cary, NC, US), was used to perform the analyses in this study.

Results

CTS and known risk factors

The demographic data of the population are shown in Table 2, and the incidence rate of CTS by risk factor is shown in Table 3. The overall incidence rate was 5.61% in adults over 40 years: 1.42% in males and 4.19% in females. The occurrence rates according to age group were 2.45% in their 40s, 1.86% in their 50s, 1.08% in their 60s, 0.22% in their 70s, and 0.11% in their 80s and older. The occurrence rates of CTS with diabetes mellitus and RA were 0.91% and 0.52%, respectively, which were higher than those for other comorbidities. Moderate obesity had the highest occurrence (2.10%) among the BMI groups. Interestingly, the non-smoker group had a much higher occurrence (4.66%) rather than the ex-smoker or current smoker group.

CTS and socioeconomic status

We categorized the socioeconomic status into 18 groups based on the combination of types of insurance (self-employed or employee), premium payment amount grades and whether the participant was an insurance payer or a beneficiary (Table 2). When socioeconomic status was broadly divided into two groups by sex, the number of males who were insurance payers

was much greater than that of females, while the number of females who were beneficiaries was much greater than males (Table 2).

Those with a Grade 1 premium who were self-employed and employee insurance payers had the highest occurrence (0.33% and 0.70%, respectively) in each group. In contrast, the self-employed and employee beneficiaries and those with a Grade 3 premium showed the highest occurrence of CTS (0.66% and 0.57, respectively). The group with the highest occurrence among all groups was Grade 1 premium and employee insurance payers (0.70%). In the two insurance payer groups the occurrence of CTS tended to decrease with premium payment increase, but the tendency was not observed in the two beneficiary groups (Table 4)

In our correlation analyses of known risk factors and the occurrence of CTS, the HR decreased as age increased (HR=0.977, $p<0.0001$); the HR of females was 3.005 ($p<0.0001$), which was almost three times higher than that of the male group. The HR was 1.252 ($p<0.0001$) in the overweight group, 1.461 ($p<0.0001$) in the moderate obesity group, and 1.654 ($p<0.0001$) in the severe obesity group. In addition, the HR was 1.224 for DM, 1.448 for RA, 1.267 for gout, and 2.089 for Raynaud's syndrome with statistical significance ($p<0.0001$). However, ESRD, hypothyroidism and smoking were not correlated with CTS occurrence (Table 5).

Our analyses of CTS occurrence according to socioeconomic status revealed that those with a lower grade of premium payment had a higher HR, which led to CTS being observed in three specific groups: self-employed insurance payers, employee insurance payers and employee insurance beneficiaries. Therefore, the risk for CTS occurrence rose as socioeconomic status

decreased (Table 6). In addition, the HRs of the beneficiaries were greater than those of the insurance payers for each type of health insurance.

Discussion

The basic mechanism of CTS's occurrence is ischemia of the median nerve caused by increased pressure within the carpal tunnel due to a disorder of the intraneural microcirculation of the nerve or by the alteration of the surrounding connective tissue, such as subsynovial connective tissue hypertrophy and synovial tissue hypertrophy.¹⁸⁻²⁰

This study showed that risk factors including female sex, age in the fourth decade, a higher BMI, and a diagnosis of DM, RA, gout, or RS were related to the onset of CTS. It is well known that CTS is more common in women, especially in middle age. The occurrence of CTS in women is two to four times higher than in men.^{6,21} Our study also showed that the occurrence ratio of females to males was 2.95.

Many studies have reported that increasing age is associated with the onset of CTS.²¹⁻²³ However, in our study, the HR for age was 0.997, which indicated that the occurrence of CTS decreased as age increased. One possible explanation for this is that the population in the current study was limited to participants who received periodic health screenings and were in their 40s or older. Considering that the highest occurrence was in the fourth decade (2.45%), we can also infer that overuse of the hands and wrists during this period may be one of the causative factors of CTS. During their 40s, many women are still working or are busy taking care of babies and doing household chores, which may increase their risk.

Our study showed that a higher BMI was associated with a higher HR. These findings coincided with those of previous studies that reported higher BMI as one of the major risk factors for CTS.^{21,23-26} The suggested hypothesis is that increased fat tissue inside the carpal tunnel increases hydrostatic pressure or that water accumulation is accelerated in connective tissues and therefore causes median nerve compression.^{7,23,24,26}

DM is also a well-known risk factor for CTS.^{23,27,28} Our results supported this notion because the HR of DM was >1. Previous studies have reported that CTS is involved in up to one-third of patients with DM and is three times as prevalent in a diabetic population compared to a healthy population.^{27,29} The reasons for this difference are that the median nerve undergoes repeated yet undetected microtrauma and fluid accumulates within the confined space of the carpal tunnel due to metabolic changes.^{29,30} A nationwide population-based cohort study conducted in Taiwan on patients with DM revealed that women and younger patients with DM had the highest risk for diabetic hand syndromes (DHS), including CTS.³¹ However, a different study reported that type II DM was not a risk factor for CTS.³² Although it can be argued that it is difficult to clarify the pathogenesis of CTS in diabetic patients,²⁸ our results support the claim that DM is a major risk factor for CTS.

RA is a chronic inflammatory disease accompanied by various extra-articular manifestations and progressive articular damage.³³ It frequently causes tenosynovitis and can anatomically alter the carpal tunnel.³⁴ RA is a known risk factor for CTS because the tenosynovitis caused by RA increases intracarpal pressure and injures the median nerve.^{29,34,35} The result of our study supported that RA is one risk factor for CTS.

Similarly, gout is also known to cause inflammation in soft tissues and to produce gouty tophi, which can cause CTS.^{36,37} In previous studies, gout was reported to be a comorbidity associated with CTS,^{36,38} and this claim is consistent with our findings.

RS is caused by vasculitis associated with systemic inflammatory disorders and results in impaired microcirculation.^{39,40} Autonomic dysfunction may occur in RS or CTS, which can produce Raynaud's phenomenon symptoms⁴¹. Alternatively, both conditions may be present concurrently.^{39,40} A meta-analysis found that CTS and RS were statistically related. In our study, the HR of RS (2.089) was the second highest among all CTS risk factors.

According to our results, ESRD, hypothyroidism and smoking were not associated with CTS. Previous studies have identified a controversy between smoking and CTS. One meta-analysis reported that current smoking and CTS were associated in cross-sectional studies but not in cohort studies,⁴² although one cross-sectional study with a population of 514 found that smoking decreased the incidence of CTS.²⁷ However, men are more likely to be smokers than women, so smoking may be a compounding factor; therefore, cross-sectional studies are insufficient to conclude that there is a correlation between smoking and CTS.⁴²

ESRD patients currently receiving renal dialysis are likely to develop carpal tunnel syndrome due to amyloid deposits in the soft tissue that are similar to gout tophi. In fact, many previous studies have reported a correlation between ESRD and the occurrence of CTS.⁴³⁻⁴⁵ However, most of these studies were conducted using small populations;^{44,45} large-scale studies have not yet been conducted. Our investigation of a large population revealed that ESRD was not associated with CTS. Thus, we think the results of our study are more objective.

In one cross-sectional study, a correlation was identified between hypothyroidism and CTS²⁷. In a different meta-analysis, there was a modest association between hypothyroidism and CTS, but evidence of a publication bias may account for this correlation.⁴⁶ An investigation of 1 million people in Taiwan reported that CTS that occurred in patients under the age of 39 was related to hypothyroidism, but CTS in those over 40 was not.³⁸ The results of our study conducted using large population were in agreement.

After analyzing the relationship between socioeconomic status and the occurrence of CTS, we found that those with a Grade 1 premium who were self-employed insurance payers and also those with a Grade 1 premium who were employee insurance payers had the highest incidence rate (0.33% and 0.70%, respectively) in each group. In addition, the HR increased as the socioeconomic status decreased. Therefore, we can say that a low socioeconomic status was associated with the incidence of CTS.

The HR was higher in the beneficiary group than in the insurance payer group because there were a lot of women in the beneficiary group. Since Korean society is still a patriarchal Confucian society, men are usually the head of a family and thus are the main insurance payers and usually are responsible for the household economy. Women are more likely to be beneficiaries

People with Medicaid did not have a higher incidence of CTS occurrence in this study. Their average age was around 60 years, and this group included many people with disabilities, no income or no occupation. Therefore, we can infer that people with Medicaid were less likely to engage in physical and economic activity using their hands than other groups.

Although our study did not directly categorize participant occupations, they can be estimated indirectly through the amount of premium payments. The premium rate reflects the economic status of the household in South Korea. People who have occupations that require simple but repetitive manual labor receive a low salary. A report on Korea's average hourly wage since 2009 revealed that those in the manufacturing industry receive 14,084 KRW per hour, while construction workers are paid 15,605 KRW hourly. In contrast, the mean wage of white-collar jobs, such as education and banking/insurance were 20,250 KRW and 20,851 KRW, respectively. The average amount of time worked was found to be 173.8 hours per month for manufacturing workers but only 137.9 hours per month in education.⁴⁷ After examining a previous study of the occurrence of CTS by occupation, we found that the relative risk that working in the food industry would lead to CTS was highest among the industries that require continuous hand use to handle products that are rapidly manufactured. However, the relative risk for those in the service industry, such as employees in a hotel, was relatively low.²² In another study that separated participants by gender and type of work, both male and female blue-collar workers and low-grade white-collar workers demonstrated a higher occurrence of CTS in the occupational category. Therefore, we can conclude that a lower socioeconomic status was associated with the incidence of CTS, and our study supported these findings.

A strong point of our study is that it was a nationwide, 11-year follow-up cohort model with sample size over 500,000; the quality of the data is also objective and reliable because we used the NHIS database. A second merit of our study is that we carried out several research tasks at once: validation of the known risk factors for CTS, determining the incidence rate of CTS

according to four grades of premium payment and identifying a correlation between CTS occurrence and socioeconomic status

Our study also had a few limitations. First, we did not include any participants under the age of 40 years because the national periodic health screening is only offered to people in their 40s or older. Second, the diagnosis of CTS was made using the results of electrodiagnostics (electromyography and nerve conduction velocity) along with the clinical impression of doctors who examined the patients. In addition, this study assumed that the risk factors and socioeconomic status that existed during the initial year from 2002–2003 would persist for the next 10 years unchanged or with a little change. However, smoking, BMI and the amounts of premium payments are subject to change. For example, if an employee becomes unemployed or starts his or her own business, the type of health insurance will change from employee insurance to Medicaid or self-employed insurance.

Conclusion

In our study, we validated the following risk factors for CTS: female sex, an age from 40–49 years, high BMI, DM, gout, and RS. However, smoking, hypothyroidism and ESRD were not associated with CTS. We also concluded that CTS was significantly increased in people with low socioeconomic status who worked in simple but repetitive manual labor jobs. We believe that the results of our study will be helpful in determining the pathophysiology of CTS and establishing a new industrial health policy.

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 84

Table 1. Four groups according to 2003 health insurance premiums.

Classification	Income quantile	Employee insurance KRW (US dollars)	Self-employed insurance KRW (US dollars)
Group 1	1	9,945 (8.29)	8,531 (7.11)
	2	24,625 (20.52)	29,120 (247.27)
	3	49,345 (41.12)	40,541 (33.78)
Group 2	4	83,720 (69.77)	64,603 (53.84)
	5	128,145 (106.79)	93,892 (78.24)
	6	182,225 (151.85)	140,893 (117.41)
Group 3	7	259,505 (216.25)	227,161 (189.30)
	8	384,443 (320.36)	366,403 (305.34)
	9	569,525 (474.60)	590,686 (492.23)
Group 4	10	843,945 (703.29)	982,721 (818.93)

Abbreviations: KRW; Korea Republic won, US dollar; United States dollar

1 US dollar ≡ 1,200 KRW

Table 2. Demographic differences according to type of insurance and premium payment grades

		Male	Female	Mean age
Self-employed insurance payer	Grade 1	14,923	14,217	59.73
	Grade 2	22,312	8,627	55.07
	Grade 3	32,162	5,858	53.28
	Grade 4	13,774	1,488	55.32
Self-employed insurance beneficiary	Grade 1	548	9,855	59.78
	Grade 2	1,093	19,814	54.15
	Grade 3	1,559	31,816	51.93
	Grade 4	675	14,221	53.37
Employee insurance payer	Grade 1	28,147	27,959	51.25
	Grade 2	30,830	7,868	48.47
	Grade 3	61,100	8,711	45.83
	Grade 4	38,150	3,601	48.45
Employee insurance beneficiary	Grade 1	6,408	13,428	55.98
	Grade 2	8,440	18,786	57.50
	Grade 3	13,868	31,163	60.08
	Grade 4	4,359	16,137	58.68
Medicaid	Insurance payer	355	423	60.20
	Beneficiary	18	249	59.03

Table 3. The incidence of carpal tunnel syndrome according to known risk factors

	Carpal tunnel syndrome and its incidence		
	Yes	No	%
Overall	28,792	484,150	5.61
Age			
40s	12,548	212,540	2.45
50s	9,526	135,750	1.86
60s	5,540	99,228	1.08
70s	1,148	35,252	0.22
80s	30	1,380	0.11
Gender			
Male	7,308	27,1413	1.42
Female	21,484	212,737	4.19
Comorbidities			
Diabetes mellitus	4,647	64,865	0.91
Rheumatoid arthritis	2,683	23,965	0.50
Gout	462	6,744	0.09
End-stage renal disease	91	1,371	0.02
Hypothyroidism	487	5,209	0.09
Raynaud's syndrome	56	305	0.01
BMI			
BMI ≤ 18.5	339	11,599	0.07
$18.5 < \text{BMI} \leq 22.9$	8,258	173,003	1.66
$22.9 < \text{BMI} \leq 24.9$	7,804	131,635	1.52
$24.9 < \text{BMI} \leq 29.9$	10,754	154,140	2.10
$30 < \text{BMI}$	1,339	13,322	0.26
Smoking History			
Non-smoker	22,872	306,287	4.66
Ex-smoker	1,333	42,293	0.27
Current smoker	3,480	114,985	0.71

Table 4. The incidence of CTS based on types of insurance and socioeconomic status

		Carpal tunnel syndrome		
		Yes	No	%
Socioeconomic status				
Self-employed insurance payer	Grade 1	1,690	27,450	0.33
	Grade 2	1,585	29,354	0.31
	Grade 3	1,551	36,469	0.30
	Grade 4	537	14,725	0.10
Self-employed insurance beneficiary	Grade 1	905	9,498	0.18
	Grade 2	2,169	18,738	0.42
	Grade 3	3,372	30,003	0.66
	Grade 4	1,207	13,689	0.24
Employee insurance payer	Grade 1	3,606	52,500	0.70
	Grade 2	1,630	37,068	0.32
	Grade 3	1,776	68,035	0.35
	Grade 4	894	40,857	0.17
Employee insurance beneficiary	Grade 1	1,579	18,257	0.31
	Grade 2	2,143	25,083	0.42
	Grade 3	2,927	42,104	0.57
	Grade 4	1,161	19,335	0.23
Medicaid	Insurance payer	38	740	0.01
	Beneficiary	22	245	0.00

Table 5. Hazard ratios for known CTS risk factors

Clinical Variables	HR	95% HR confidence limits	P-value
Age	0.977	0.971–0.974	<.0001
Female	3.005	2.882–3.135	<.0001
BMI ≤18.5	0.655	0.583–0.737	<.0001
18.5< BMI ≤22.9	1		
22.9< BMI ≤24.9	1.252	1.211–1.294	<.0001
24.9< BMI ≤29.9	1.461	1.416–1.507	<.0001
30< BMI	1.654	1.553–1.762	<.0001
Non-smoker	1		
Ex-smoker	1.044	0.980–1.113	0.1834
Current smoker	0.972	0.928–1.017	0.2170
DM	1.224	1.181–1.268	<.0001
RA	1.448	1.385–1.515	<.0001
Gout	1.267	1.145–1.402	<.0001
ESRD	1.023	0.815–1.284	0.8428
Hypothyroidism	1.040	0.941–1.148	0.4440
RS	2.089	1.548–2.819	<.0001

Table 6. Multivariate Cox regression analysis of socioeconomic status and occurrence of carpal tunnel syndrome

Socioeconomic Status		Hazard ratio	95% Hazard ratio confidence limits	P-value
Self-employed insurance payer	Grade 1	1		
	Grade 2	0.890	1.027–0.953	<.0001
	Grade 3	0.721	0.936–0.868	<.0001
	Grade 4	0.631	0.913–0.822	<.0001
Self-employed beneficiary	Grade 1	1.497	0.997–0.913	<.0001
	Grade 2	1.823	1.069–0.997	<.0001
	Grade 3	1.821	1.026–0.962	<.0001
	Grade 4	1.426	0.819–0.755	0.6086
Employee insurance payer	Grade 1	1.094	0.901–0.845	<.0001
	Grade 2	0.704	0.801–0.742	<.0001
	Grade 3	0.432	0.520–0.482	<.0001
	Grade 4	0.351	0.472–0.431	<.0001
Employee beneficiary	Grade 1	1.386	1.030–0.956	0.0009
	Grade 2	1.350	1.020–0.951	0.0001
	Grade 3	1.134	0.897–0.840	0.6486
	Grade 4	0.985	0.708–0.652	<.0001
Medicaid	Insurance payer	0.802	0.792–0.558	0.3454
	Beneficiary	1.411	0.973–0.619	0.3411

Fig 1. Flow chart for sampling and selecting the participants.

Abbreviations: ICD-10, International Classification of Diseases, CTS, Carpal tunnel syndrome