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Medical and non-medical correlates of carpal tunnel syndrome in a Taiwan cohort of one million

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Background: Carpal tunnel syndrome (CTS), with unclear etiology, is the most common entrapment neuropathy. Its occurrence is related to lots of medical and non-medical conditions with uncertain causality. With a large population, we characterized selected demographical and clinical factors to add more information on CTS correlated factors and new insight into future CTS prevention.

Methods: A national insurance claim dataset of one million in Taiwan was used to identify 15,802 CTS cases and 31,604 randomly selected controls, during a period of seven years starting January 1, 2000. Statistical association with CTS was determined for five sociodemographic and nine medical factors.

Results: Patients were predominantly female (65.6% vs. 47.7% in the control group) and older (40 and above, 62.6% vs. 36.2%). Rheumatoid arthritis was found to be the most significant comorbidity associated with CTS, followed by gout, hypertension, diabetes, obesity, uremia, and acromegaly. For younger group age $\leqq 39$, the association of these comorbidities was stronger, and hypothyroidism and vitamin B_6 deficiency were additional comorbidities. Aging appears to reduce the relative impact of the diseases commonly associated with CTS as the possible risk factors.

Conclusions: Identification of the CTS correlates in younger group would be of greater value in timely detection and treatment of these diseases. Correcting these disorders may aid in removing possible causes of CTS. This is the first report on the

effect of aging on probable CTS risk factors. How factors associated with aging contribute to the development of CTS remains to be determined.

Key words: carpal tunnel syndrome, case-control study, comorbidities, statistical association.

Introduction

Carpal tunnel syndrome (CTS) is known to be the most common entrapment neuropathy [1]. It is produced by compression of the median nerve inside the carpal tunnel due to overuse or strain in hand activities [2]. Over one half of the patients have symptoms in both hands, with the remainder having symptoms more in the dominant hand than in the non-dominant hand [3].

The prevalence of CTS was estimated to be around 5% in the general population [4]. CTS can occur at any age, and it is most common among females in the fifth and sixth decades of life [3]. The etiology of CTS is unclear though strong association has been observed between CTS and a number of occupational and non-occupational factors. Nerve compression has been correlated with occupations that involve repetitive wrist movements, awkward wrist positions, and the use of vibrating machinery [5]. Non-occupational or personal correlates of CTS include age, gender, pregnancy, obesity, diabetes mellitus (DM), hypothyroidism, rheumatoid arthritis (RA), hemodialysis, and acromegaly [6,7].

In the present population-based study, we took advantage of the large size of a National Health Insurance (NHI) claim dataset available in Taiwan to examine more precisely the independent association between CTS and each of its medical and non-medical correlates in a randomly selected cohort of one million enrollees for a

period of seven years starting January 1, 2000. Among CTS comorbidities, some are more health-threatening than CTS. Upon statistical confirmation, these graver disorders should be considered along with CTS for their early detection and timely treatment.

Methods

The NHI program of Taiwan was instituted in 1995, which has now covered over 96% of the entire national population of some 23 million. We obtained a set of NHI claim data for the period of 1996-2007 of up to 1,000,000 enrollees randomly selected by the National Health Research Institute in 2005. From this cohort of one million, we identified new patients as cases who received care for CTS for at least 3 times during a period of 7 years starting January 1, 2000. Controls were randomly selected from among the cohort who did not have a record of CTS, at a control to case ratio of 2:1. The *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM) code 354.0 or A-code 229 was used to identify CTS cases and comorbidities (Table 1). Patient identification numbers were scrambled, and hence no ethics board approval was needed because the researchers were blinded to the patient identities.

Data analysis

From the cohort of one million, 15,802 cases and 31,604 controls were identified in the dataset for the seven years specified. Among the 15802 cases, 7,575 (47.9%) received nerve electrophyiological studies and 969 (6.13%) underwent surgical interventions for CTS. Non-medical, sociodemographic characteristics including

gender, age, occupation code, income, and urbanization levels of residence area were compared between cases and controls. With quartiles of population densities, the urbanization levels were stratified into 3 levels: low (lowest 50%, < 662 persons/km^2), moderate (median 25%, 662-1822 persons/km^2), and high (highest 25%, > 1822 persons/km^2). The univariate analysis was used as a screening test for preliminary assessment of correlation between the sociodemographic or medical characteristics and CTS. Once found significantly correlated, each of the variables was then tested with the multivariate logistic regression analysis in order to estimate the association strength of the individual variables to CTS in terms of odds ratios (OR).

Based on literature review, we selected nine medical conditions including hypertension, DM, obesity, gout, uremia, vitamin B_6 deficiency, RA, hypothyroidism, and acromegaly, as possible comorbidities of CTS [1], for analyses. The A-codes and ICD-9-CM codes of these comorbidities are listed in Table 1. The association strength of each of these medical conditions to CTS was estimated based on significance of differences in the prevalence of each comorbidity between cases and controls by the Chi-square test. Significant correlates in the univariate analysis were included in the multivariate logistic-regression model while controlling sociodemographic variables to identify the most important medical correlates of CTS. Separate multivariate

logistic regression analyses were performed for age and for gender difference.

Results

The sociodemographic characteristics of cases and controls were compared as shown in Table 2. There was a female predominance in cases and a male predominance in controls. Individuals at age 40-59 (49.5% vs. 26.2%), higher income earners (20.2% vs. 15.5%), and high urbanization living (70.5% vs. 68.5) were in greater proportions in cases than in controls. Female gender and age range stood out to be the most significant non-medical factors associated with CTS.

Comparison between cases and controls of the prevalence of nine possible comorbidities associated with CTS (Table 3) revealed that the most prevalent comorbidities were, in descending order, RA, acromegaly, hypertension, gout, DM, uremia, hypothyroidism, obesity, and vitamin B_6 deficiency. This ranking is similar to that seen in the group of age 40-59 (Table 4), the most vulnerable group of CTS (Table 2). However, the relative significance of these comorbidities in the younger group of age $\leqq$39 was quite different (Table 4). In the younger group, the most significant comorbidities were gout, followed by RA, obesity, DM, hypertension, hypothyroidism, vitamin B_6 deficiency, uremia, and acromegaly (Table 4). Also, the strength of association was considerably greater in the younger group than in the older group, indicating that age did not have a strong confounding effect. Vitamin B_{12} deficiency is a potential cause of CTS. In the present study, it is not found to be a

1 significant contributing factor (data not shown).

2 The results of univariate analysis confirmed that RA, DM, obesity, gout,

3 hypertension, hypothyroidism, vitamin B_6 deficiency, uremia, and acromegaly were

4 more prevalent in cases than in controls (Table 5). Multivariate logistic regression

5 analysis revealed most significant correlates of CTS being age at 40-59, obesity, gout,

6 RA, male gender, and DM.

7 Further analysis by gender indicated that the association between comorbidities

8 and CTS was similar between males and females (Table 6).

Discussion

CTS is a common disorder of the peripheral nervous system and a cause of considerable hand dysfunction. Literature review [5] reveals that both occupational (industrial) and non-occupational (personal) factors were related to the development of CTS, but there is controversy regarding the etiological contributions of these factors [5]. The most significant socio-demographic characteristics associated with CTS were female gender, advance in age (≥ 40 years), and higher income [1,6]. The most significant concurrent medical conditions were RA, DM, obesity, gout, hypertension and hypothyroidism [1]. Our results from Taiwan populations are not in full agreement with what was reported in the literature.

Sociodemographic characteristics

A number of studies, including our own, have found that development of CTS is increasing with age [3,4,6,8]. The prominently high prevalence of CTS in the age group of 40 to 59 (Table 2) coincided with this group being the major constituent of workforce, suggesting the correlation between occupational factors and CTS. The relatively high rate of CTS in the age group of > 60 can probably be attributed to age-related carpal tunnel changes.

Correlation of female gender with CTS has been well documented [1,3,4,6,8].

Blandetal et al. reported that CTS was more prevalent in females although its severity was greater in males and in the elderly [3]. Among the elderly, the prevalence in females was almost four times of that in males [6,8]. Our results indicate that CTS was twice as prevalent in females as in males (Table 2). This ratio differs from those found in the literature, being from 1.4:1 to 6.0:1 [1,3,6,9-12] averaging 3:1 [2]. Several factors may have contributed to this difference, including ethnic characteristics and varying gender distributions of sociodemographic factors and comorbidities, which were closely associated with CTS. In Taiwan, we found males had higher employment rate, older mean age, and higher income than females (data not shown). Also, males tend to be more susceptible to uremia, hypertension, gout and acromegaly (data not shown).

The relationship between income and CTS was evaluated by a study of Tanaka, et al. [6], in which an annual family income of ≥ 20,000 U.S. dollars was shown to be associated with CTS (adjusted OR = 1.5). A similar correlation between higher income (≥ 30,000 New Taiwan Dollars per month) and CTS (adjusted OR = 1.15, Table 5) was found in our study. Certain blue-collar occupations were reported to be associated with CTS in both males and females [9-11]. We found a similar association between blue-collar occupations and increased risk of CTS (OR = 1.25).

So far, we have found no study in the literature addressing the relationship

between urbanization of living and CTS. We are the first to observe that people living in a relatively urbanized area had a higher risk for CTS (OR = 1.07).

Comorbidities

RA is a well documented condition associated with CTS [12-14]. In a systematic review, van Dijk et al. reported that the prevalence of concurrent RA, DM, and hypothyroidism was higher in CTS cases than in controls [13]. In our study, we found that RA had, among the comorbidities tested, the strongest association with CTS. This association was stronger in males than in females.

Positive correlations between obesity and CTS [6,8,12,13] and between DM alone and CTS [8,12-14] have been observed in a number of studies. These positive correlations were also found in our study (Table 5).

Hypertension is a common medical problem associated with CTS. It can occur as a solitary disorder or in combination with medical conditions concurrent with CTS, such as acromegaly [15], vitamin B_6 deficiency [16], and metabolic syndrome [14,17]. According to Edwards, et al. [18], hypertension could impair the sensory nerve conduction through elevation of cutaneous sensory thresholds and reduction of sensory action potential amplitudes. The causal link of these conditions is unclear. Our results confirm a strong association between hypertension and CTS (Table 5) and

thus suggest that hypertension-related conduction impairment of the sensory nerves might be a risk factor.

The relationship between gout and CTS has been well documented [19,20]. Kang, et al. [20] reported that tophus deposition in the carpal tunnel can lead to CTS. In addition, imaging studies have shown the presence of tophi in the floor of the carpal tunnel, carpal bones, radiocarpal joint, and extensor tendons or tendon sheaths of the wrist [19]. Our results confirm the strong association between gout and CTS (OR = 2.29).

Numerous findings have suggested that hypothyroidism is a significant risk factor for CTS [6,8,21,22]. In a study by Duyff et al. [22], 29% of hypothyroid patients were found to have CTS. In our study, we found a positive correlation between hypothyroidism and CTS (OR = 1.38). Primary hypothyroidism is an autoimmune disorder, which is more prevalent in younger populations. It follows that the association between hypothyroidism and CTS should be strongest among individuals younger than 40. Our results indicate that the association was more than thrice stronger (OR = 3.43 vs. 1.05, Table 4) in this group than in the older ones.

Though vitamin B_6 is widely found in foods, a considerable number of people suffer a vitamin B_6 deficiency [16], maybe due to abnormalities in vitamin B_6 metabolism [16] or uptake. It has been documented that CTS was associated with

vitamin B_6 deficiency [1,8,16], and supplements of the vitamin have proved to be a successful treatment in some cases [1,16]. Although vitamin B_6 deficiency was rare in Taiwan, our results indicate its significant association with CTS in females especially at age 20-39 (OR = 2.57).

Uremia is a metabolic disorder caused by chronic renal dysfunction. Studies have shown that uremia is associated with CTS in patients undergoing hemodialysis [23, 24] and peritoneal dialysis [24]. In our study, uremia was found associated with CTS, more in males than in females.

Acromegaly is a rare disease caused by over-secretion of growth hormone [25]. Its relationship with CTS has been well documented [13,15,25]. Colao, et al. [15] reported that 20-64% of acromegaly patients suffered from symptomatic CTS. In our study, a similar relationship between acromegaly and CTS was found in both genders.

Features of study

One strength of the present study is that cases and controls were identified from a dataset of one million enrollees in a national insurance program covering over 96% of the entire population in Taiwan. Insurance claims of consecutive cares for CTS ensured the diagnosis of CTS. The demographic profiles and comorbidities noted in this cohort are in accord with those reported in the literature. The large sample size

gave adequate power for statistical analyses and enabled us to ascertain important associations between comorbidities and CTS. However, we could not rule out the possibility of over-diagnosing CTS since only 6.13% of the patients with CTS were operated. It is also possible that some in the control group with asymptomatic or mild CTS might have escaped the diagnosis. Thus, the risks derived from the present study may be underestimated. Even though surgery is covered by the NHI system, low operation rate is noted in the present study because surgery is entertained as the last resort among CTS patients in Taiwan. It should be noted that our study was designed only to demonstrate statistical associations but not causal relationships. Further studies are needed to elucidate the etiological relationships and the mechanisms of these associations of interest.

Our results indicate that the most significant non-medical correlates of CTS were female gender, age > 40, higher income, blue-collar occupations, and high urbanization level of living (Table 2). In females in general, most significant comorbidities of CTS were RA, DM, obesity, and gout (Table 6), while at the most vulnerable age range of 40-59, these were RA, hypertension, DM, and gout (Table 4). CTS thus serves to alert the possible presence of these related comrobidities for timely treatment, some of these are more health-threatening such as RA and DM.

Correlation of the comorbidities chosen in this study with CTS has been reported

in a large number of studies. But most of these reports were based on relatively small number of CTS patients. With a large patient number in our study, we were able to discern a hitherto obscure aging-related dilution of correlation strength between most of these comorbidities and CTS as shown in Table 4. For the younger population, the comorbidities were more strongly associated with CTS, and CTS would be of greater value to serve as a precautionary sign to alert for timely diagnosis and treatment of more serious concurrent disorders. In older populations, although the correlation between the comorbidities and CTS still existed, it became less important (Table 4). The factor that caused this dilution effect is unclear and warrants further mechanistic studies for its elucidation.

Author contributions

Drs. Tseng, Liao, Sung, Hsieh and Tsai designed the study and developed the manuscript; data analysis was performed by Kuo, Liao and Sung.

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Disclosure

The authors disclose no conflicts of interest.

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Table 1 A-codes and ICD-9-CM codes of comorbidities of CTS

Comorbidity	A-codes	ICD-9-CM codes
Rheumatoid arthritis (RA)	A430	714.0, 714.1, 714.2, 714.30, 714.31, 714.32, 714.33
Acromegaly	A189	253.0
Hypertension	A260, A269	401.0, 401.1, 401.9, 402.00, 402.01, 402.10, 402.11, 402.90, 402.91, 403.00, 403.01, 403.10, 403.11, 403.90, 403.91, 404.00, 404.01, 404.02, 404.03, 404.10, 404.11, 404.12, 404.13, 404.90, 404.91, 404.92, 404.93, 405.01, 405.09, 405.11, 405.19, 405.91, 405.99
Gout	A189	274.0, 274.10, 274.11, 274.19, 274.81, 274.82, 274.89, 274.9
Diabetes mellitus (DM)	A181	250.00, 250.01, 250.02, 250.03, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33, 250.40, 250.41, 250.42, 250.43, 250.50, 250.51, 250.52, 250.53, 250.60, 250.61, 250.62, 250.63, 250.70, 250.71, 250.72, 250.73, 250.80, 250.81, 250.82, 250.83, 250.90, 250.91, 250.92, 250.93
Uremia	A350	585
Hypothyroidism	A180	243, 244.0, 244.1, 244.2, 244.3, 244.8, 244.9
Obesity	A183	278.00, 278.01
Vitamin B_6 (Vit. B_6) deficiency	A193	266.1

ICD-9-CM, International Classification of Diseases, 9th Revision, Clinical Modification.

CTS, carpal tunnel syndrome.

Table 2 Baseline sociodemographic characteristics of CTS cases and controls in Taiwan, 2000-2007

	Controls N=31,604		Cases N=15,802		Total N=47,406		
Variable	n	(%)	n	(%)	n	(%)	*p* Value
Gender							<0.0001
Female	15,085	(47.7)	10,370	(65.6)	25,455	(53.7)	
Male	16,519	(52.3)	5,432	(34.4)	21,951	(46.3)	
Age, years							<0.0001
≤ 19	8,951	(28.3)	630	(4.0)	9,581	(20.2)	
20-39	11,217	(35.5)	5,278	(33.4)	16,495	(34.8)	
40-59	8,284	(26.2)	7,823	(49.5)	16,107	(34.0)	
≥ 60	3,152	(10.0)	2,071	(13.1)	5,223	(11.0)	
Occupation							<0.0001
White collar	17,273	(54.7)	7,714	(48.8)	24,987	(52.7)	
Blue collar	9,195	(29.1)	5,567	(35.2)	14,762	(31.1)	
Others	5,136	(16.3)	2,521	(16.0)	7,657	(16.2)	
Urbanization							<0.0001
Low	3,781	(12.0)	1,805	(11.4)	5,586	(11.8)	
Moderate	6,165	(19.5)	2,852	(18.1)	9,017	(19.0)	
High	21,658	(68.5)	11,145	(70.5)	32,803	(69.2)	
Income							<0.0001
< 30,000 NTD	26,704	(84.5)	12,605	(79.8)	12,605	(82.9)	
≥ 30,000 NTD	4,900	(15.5)	3,197	(20.2)	3,197	(17.1)	

Cases in 2000-2007 used outpatient services for CTS treatment.

CTS, carpal tunnel syndrome; NTD, New Taiwan Dollars.

Table 3 Prevalence of **c**omorbidities in CTS cases and controls in Taiwan, 2000-2007

	Control N=31,604		Case N=15,802		Total N=47,406		
Variable	n	(%)	n	(%)	n	(%)	*p* Value
Uremia							<0.0001
No	31,280	(99.0)	15,433	(97.7)	46,713	(98.5)	
Yes	324	(1.0)	369	(2.3)	693	(1.5)	
Vit. B_6 deficiency							<0.0001
No	31,546	(99.8)	15,732	(99.6)	47,278	(99.7)	
Yes	58	(0.2)	70	(0.4)	128	(0.3)	
Rheumatoid arthritis							<0.0001
No	31,202	(98.7)	15,093	(95.5)	46,295	(97.7)	
Yes	402	(1.3)	709	(4.5)	1,111	(2.3)	
Hypothyroidism							<0.0001
No	31,357	(99.2)	15,482	(98.0)	46,839	(98.8)	
Yes	247	(0.8)	320	(2.0)	567	(1.2)	
Obesity							<0.0001
No	31,475	(99.6)	15,589	(98.6)	47,064	(99.3)	
Yes	129	(0.4)	213	(1.4)	342	(0.7)	
Hypertension							<0.0001
No	31,217	(98.8)	15,247	(96.5)	46,464	(98.0)	
Yes	387	(1.2)	555	(3.5)	942	(2.0)	
Diabetes							<0.0001
No	31,364	(99.2)	15,380	(97.3)	46,744	(98.6)	
Yes	240	(0.8)	422	(2.7)	662	(1.4)	
Gout							<0.0001
No	31,289	(99.0)	15,307	(96.9)	46,596	(98.3)	
Yes	315	(1.0)	495	(3.1)	810	(1.7)	
Acromegaly							<0.0001
No	31,056	(98.3)	15,197	(96.2)	46,253	(97.6)	
Yes	548	(1.7)	605	(3.8)	1,153	(2.4)	

Cases in 2000-2007 used outpatient services for CTS treatment.

CTS, carpal tunnel syndrome; Vit. B_6, vitamin B_6.

Table 4 Estimated risk and 95% confidence interval of CTS by age in relation to comorbidities controlling sociodemograhic characteristics in multivariate logistic analysis in Taiwan, 2000-2007

	Age, years		
	≤ 39	40-59	≥ 60
Variable	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Uremia			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	2.63 (1.86-3.70)	1.48 (1.15-1.85)	1.30 (0.99-1.69)
Vit. B_6 deficiency			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	2.73 (1.43-5.23)	1.09 (0.62-1.94)	1.66 (0.84-3.28)
Rheumatoid arthritis			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	4.22 (2.99-5.95)	2.48 (2.03-3.02)	1.67 (1.36-2.05)
Hypothyroidism			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	3.43 (2.52-4.67)	1.05 (0.82-1.34)	0.85 (0.56-1.28)
Obesity			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	3.72 (2.67-5.18)	1.70 (1.19-2.42)	2.44 (1.18-5.04)
Hypertension			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	3.59 (2.43-5.29)	2.03 (1.66-2.49)	1.42 (1.14-1.78)
Diabetes			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	3.69 (2.40-5.67)	2.00 (1.58-2.55)	1.82 (1.37-2.41)
Gout			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	5.17 (3.67-7.26)	2.16 (1.74-2.70)	1.79 (1.38-2.31)
Acromegaly			
No	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Yes	2.15 (1.60-2.88)	1.43 (1.19-1.71)	1.41 (1.14-1.75)

CTS, carpal tunnel syndrome; CI, confidence interval; Vit. B_6, vitamin B_6.

Table 5 Estimated risk of CTS in relation to comorbidities controlling sociodemograhic characteristics in multivariate logistic analysis, Taiwan, 2000-2007

	Univariate	Multivariate
Variable	Odds ratio (95% CI)	Odds ratio (95% CI)
Gender		
Female	2.09 (2.01-2.17)	1.00 (Reference)
Male	1.00 (Reference)	2.13 (2.04-2.22)
Age, years		
≤ 19	1.00 (Reference)	1.00 (Reference)
20-39	6.69 (6.13-7.29)	6.25 (5.72-6.83)
40-59	13.4 (12.3-14.6)	11.4 (10.5-12.5)
≥ 60	9.33 (8.46-10.3)	7.52 (6.79-8.33)
Occupation		
White collar	1.00 (Reference)	1.00 (Reference)
Blue collar	1.36 (1.30-1.42)	1.25 (1.18-1.31)
Others	1.10 (1.04-1.16)	1.06 (0.99-1.13)
Urbanization		
Low	1.00 (Reference)	1.00 (Reference)
Moderate	0.97 (0.90-1.04)	1.03 (0.95-1.12)
High	1.08 (1.02-1.15)	1.07 (0.98-1.14)
Income		
< 30,000 NTD	1.00 (Reference)	1.00 (Reference)
≥ 30,000 NTD	1.38 (1.32-1.45)	1.15 (1.09-1.22)
Uremia		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.31 (1.99-2.68)	1.50 (1.28-1.76)
Vit. B_6 deficiency		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.42 (1.71-3.43)	1.51 (1.04-2.19)
Rheumatoid arthritis		
No	1.00 (Reference)	1.00 (Reference)
Yes	3.65 (3.22-4.13)	2.21 (1.94-2.52)
Hypothyroidism		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.62 (2.22-3.10)	1.38 (1.16-1.65)
Obesity		
No	1.00 (Reference)	1.00 (Reference)
Yes	3.33 (2.67-4.15)	2.30 (1.82-2.91)

Hypertension		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.93 (2.57-3.35)	1.84 (1.60-2.11)
Diabetes		
No	1.00 (Reference)	1.00 (Reference)
Yes	3.59 (3.06-4.21)	2.04 (1.72-2.41)
Gout		
No	1.00 (Reference)	1.00 (Reference)
Yes	3.21 (2.79-3.70)	2.29 (1.97-2.67)
Acromegaly		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.26 (2.01-2.54)	1.47 (1.29-1.66)

Adjusted for gender, age, occupation, urbanization, income, uremia, vitamin B_6 deficiency, rheumatoid arthritis, hypothyroidism, diabetes, obesity, gout, hypertension and acromegaly.

CTS, carpal tunnel syndrome; CI, confidence interval; Vit. B_6, vitamin B_6; NTD, New Taiwan Dollars.

Table 6 Estimated risk and 95% confidence interval of CTS by gender in relation to comorbidities controlling sociodemograhic characteristics in multivariate logistic analysis, Taiwan, 2000-2007

	Female	Male
Variable	Odds ratio (95% CI)	Odds ratio (95% CI)
Uremia		
No	1.00 (Reference)	1.00 (Reference)
Yes	1.39 (1.12-1.73)	1.62 (1.29-2.05)
Vit. B6 deficiency		
No	1.00 (Reference)	1.00 (Reference)
Yes	1.56 (1.01-2.42)	1.40 (0.68-2.85)
Rheumatoid arthritis		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.06 (1.74-2.44)	2.43 (1.98-2.98)
Hypothyroidism		
No	1.00 (Reference)	1.00 (Reference)
Yes	1.36 (1.13-1.65)	1.36 (0.82-2.26)
Obesity		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.27 (1.71-3.02)	2.33 (1.54-3.51)
Hypertension		
No	1.00 (Reference)	1.00 (Reference)
Yes	1.92 (1.57-2.35)	1.74 (1.44-2.12)
Diabetes		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.28 (1.82-2.86)	1.78 (1.37-2.32)
Gout		
No	1.00 (Reference)	1.00 (Reference)
Yes	2.28 (1.76-2.95)	2.33 (1.94-2.80)
Acromegaly		
No	1.00 (Reference)	1.00 (Reference)
Yes	1.42 (1.17-1.72)	1.52 (1.29-1.79)

CTS, carpal tunnel syndrome; CI, confidence interval; Vit. B_6, vitamin B_6.