Smyrna Tıp Dergisi ***Araştırma Makalesi***

Relationship Between Age, Gender, Obesity, Diabetes Mellitus and Severity of Carpal Tunnel Syndrome
Karpal Tünel Sendrom Şiddeti ile Yaş, Cinsiyet, Obezite, Diyabet Mellitus Arası İlişki

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Summary
Objectives: In order to identify risk factors for carpal tunnel syndrome (CTS) to analyze the association of age, gender, body mass index (BMI), diabetes mellitus (DM) as risk factors for severity of CTS.
Material and Methods: Patients were selected from a population of patients undergoing nerve conduction studies and electromyography with clinical diagnosis of CTS.
Results: The mean age of the patients was 53.29±11.41 (min:29, max:80). Female/male ratio was 8.3/1. Thirty-eight (33.9%) patients had DM. Fourtyseven (42%) patients belonged to the mild and 65 (58%) patients to the severe group in terms of neurophysiologic classification. Presence of DM was significantly more frequent in patients with severe CTS. And duration of complaints was also more longer in severe group. In patients with BMI>30; mean age and duration of complaints were higher in severe CTS, patients with age≥60 and presence of DM were more frequent in severe CTS. In patients with age ≥60; patients with severe CTS had more frequently BMI>30 and longer duration of complaints. Whereas, patients with age <60 had more frequent DM in severe CTS.
Conclusion: This study demonstrated that presence of DM increases the severity of CTS in females, obese ones, under the age of 60 years. Obesity increases the severity of CTS in patients with DM, over the age of 60 years.
Key words: Carpal tunnel syndrome, severity, risk factors

Özet
Amaç: Karpal tünel sendromu (KTS) şiddeti için risk faktörleri olarak yaş, cinsiyet, vücut kitle indeksi (VKİ), Diabetes mellitus (DM) arasındaki ilişkiyi analiz etmek.
Gereç ve Yöntem: KTS tanısı ile sinir iletim çalışmaları ve elektromiyografi geçiren bir hasta popülasyonu incelendi.
Bulgular: Hastaların yaş ortalaması 53.29±11.41 (min:29, max:80) idi. Kadın/erkek oranı 8.3/1 idi. Otuz sekiz (%33,9) hastada DM vardı. Nörofizyolojik sınıflandırma açısından kırk yedi (%42) hasta hafif ve 65 (%58) hasta ciddi grubuna aitti. DM varlığı ağır KTS olan hastalarda anlamlı olarak daha sık bulundu. Şikayetlerin süresi ağır grupta daha uzun bulundu. VKİ>30olan hastalarda; yaş ortalaması ve şikayetlerin süresi ağır KTS grubunda daha yüksek idi. Ağır KTS olan hastalarda yaş ortalaması daha yüksek ve DM varlığı daha sıktı. Yaş≥60 olan hastalarda; ağır KTS olan hastaların şikayet süresi daha uzun ve BMI>30 hasta sayısı daha sıktı. Oysa, yaş<60 olan hastalarda ağır KTS olan hastalarda daha sık DM vardı.
Sonuç: Çalışma DM varlığının 60 yaşın altında ve obez olanlarda KTS şiddetini arttırdığını göstermiştir. Obezitenin 60 yaşın üzerinde, DM hastalarda KTS şiddetini arttırdığı görülmüştür.
Anahtar kelimeler: Karpal tünel sendromu, hastalık şiddeti, risk faktörleri

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Background

Carpal tunnel syndrome (CTS) is the most frequent compressive neuropathy in the general population, resulting from the median nerve compression under the transverse carpal ligament. It has gender and age-related incidence frequently affects women (1,2,3,4,5,6). The most typical symptoms are numbness, tingling and pain at the territory of the median nerve in the hands occurring especially at night and weakness of the thenar muscles (7). The majority of cases are idiopathic but in some cases it is associated with diabetes mellitus, thyroid dysfunction, pregnancy, obesity, wrist fractures, rheumatoid arthritis, osteoarthritis, amyloidosis, connective tissue diseases and repetitive hand activity (8,9). Chronic mechanical compression and ischemic damage leads to injury of the median nerve within the carpal canal (10).

Body mass index (BMI) is an important risk factor for developing this compressive neuropathy in the carpal canal (11). Obesity is related to increased incidence of CTS (12,13,14,15,16,17,18). Obesity seems to be more frequent in females, but males had more severe lesions (11). Diabetes mellitus (DM) has large number of complications. CTS is seen about 20% of diabetic patients (19). The diabetes-induced connective tissue changes thought to be causing median nerve entrapment (20).

In order to identify risk factors for CTS to analyze the association of age, gender, BMI, DM as risk factors for severity of CTS, a retrospective study in a population of patients undergoing nerve conduction studies and electromyography in a period from October 2010 to December 2011 was performed.

Material and methods

Patients referred for electrodiagnostic consultation for CTS confirmation were included to the study. The study was approved by the local ethic committee. Patients with a history and symptoms consistent with cervical radiculopathy, brachial plexopathy, polyneuropathy and peripheral nerve trauma and unilateral CTS were excluded from the study. Patients were excluded in the presence of previous CTS surgery or other diseases that could be related to CTS except DM (e.g. polyneuropathy, endocrine diseases, thyroid dysfunction, wrist fractures, rheumatoid arthritis, osteoarthritis, pregnancy etc.). For each patient, epidemiologic evaluation covered age, sex, height, weight, BMI, and occupational activity. The results of occupational activity was previously published (21).

BMI was calculated as weight/height (2). Patients were classified as being underwieght (BMI≤18.5 kg/m^2), normal (BMI>18.5 and <24.9 kg/m^2), overweight (BMI≥25 and 29.9 kg/m^2), obese (BMI ≥30 and <35 kg/m^2) or morbidly obese (BMI≥35 kg/m^2) (22).

For the electrodiagnosis of CTS, the following parameters were measured on both sides using a Medelec electromyograph. Surface-stimulating and recording electrodes were used for all studies. 1- Median wrist-to-thenar distal motor latency (DML). Recording electrodes were placed over the motor point of abductor pollicis brevis and stimulation approximately 14 cm proximal to the recording cathode. DML was measured to the initial negative deflection from the baseline. 2- Wrist-to-elbow median nerve motor conduction velocity. 3- Median sensory conduction velocity of the 2nd digit to wrist measured antidromically with the recording cathode at the proximal interphalangeal joint and anode 2 cm distally. 4- Ulnar wrist-to-hypothenar DML. Recording electrodes were placed over the motor point of adductor digiti minimi and stimulation approximately 11 cm proximal to the recording cathode. 5- Ulnar sensory conduction velocity of the 5th digit to wrist measured antidromically with the recording cathode at the proximal interphalangeal joint and anode 2 cm distally. 6- Median and ulnar sensory amplitudes were measured peak-to-peak with recording of th 4th digit.

All patients were evaluated by the same researcher and skin temperature was maintained at 32–34°C. The scale considers normal and delayed values of median nerve sensory conduction velocity (SCV) and DML as well as presence or absence of sensory action potentials (SAP) and compound muscle action potentials (CMAP). It is a five point scale with 5 stages of severity; 0: normal findings, 1-Median nerve SCV and DML normal but significant difference in peak-to-peak amplitude of median and ulnar sensory amplitudes 2-Slowing of SCV, normal DML 3-Slowing of SCV and prolonged DML 4-Absence of SAP and prolonged DML 5-Absence of SAP and CMAP (5). Neurophysiologic data were assessed according to the modified neurophysiologic grading system developed by Padua et al. According to this system stages were defined as; Stage 0-2: mild, stage 3-5: severe (5).

Categorical data are reported as numbers and/or percentages and were compared by Chi-square test. Quantitative data are reported as mean±SD and were compared by Student's t-test. $P<0.05$ was considered statistically significant.

Results

A total of 112 patients wih bilateral CTS were included in the present study. Of all patients, 100 (89.3%) subjects were female, 12 (10.7%) patients were male. Female/male ratio was 8.3/1. The mean age of the patients was 53.29±11.41 (min:29, max:80). The majority of cases (67.9%) were found in the patients with age <60 and overweight in accordance with BMI (61.6%). None of the patients was underweight or morbidly obese. Thirty-eight (33.9%) patients had DM. Clinical and demographic features of the patients are shown in table 1. Fourty-seven (42%) patients belonged to

the mild and 65 (58%) patients to the severe group in terms of neurophysiologic classification. Presence of DM was significantly more frequent in patients with severe CTS. Prevalence of studied features among patients with severe and mild CTS are shown in table 2. In patients with severe CTS, DM was more frequent in females. In males, there were no differences of BMI, age, DM between mild and severe CTS. In patients with BMI >30; mean age was higher in severe CTS, patients with age≥60 and presence of DM were more frequent in severe CTS. In patients with age ≥60; patients with severe CTS had more frequently BMI>30. Whereas, patients with age <60 had more frequent DM in severe CTS. In patients with DM; patients with BMI>30 were more frequent in severe CTS. With respect to risk factors within their own group are shown in table 3.

Table 1. *Clinical and demographic features of the patients*

	All cases (n=112)
Mean age (years)	53.29±11.41 (29-80)
Age ≥60/ <60	36/76 (32.1% / 67.9%)
Female/Male	100/12 (89.3% / 10.7%)
BMI >18.5 and <24.9 kg/m2	8 (7.1%)
BMI ≥ 25 and <29.9 kg/m2	69 (61.6%)
BMI ≥ 30 and <35 kg/m2	35 (31.2%)
Presence of Diabetes Mellitus	38 (33.9%)

Table 2. *Prevalence of studied features among patients with severe and mild CTS*

	Mild (n=47)	**Severe (n=65)**	**p**
Female/Male	44/3	56/9	0.089
BMI≥30/<30	11/36	24/41	0.128
Mean age (years)	52.39±10.44	53.95±12.10	0.475
Age ≥60/ <60	13/ 34	23/ 42	0.388
Presence of Diabetes Mellitus	9	29	0.005*

Table 3. *Detailed analysis of risk factors for CTS*

	Mild (n=47)	**Severe (n=65)**	**P**
Female gender (n=100)			
BMI>30	10	21	0.113
Mean age (years)	53±10.39	53.80±11.55	0.79
Age ≥60/ <60	13/31	20/36	0.515
Presence of Diabetes Mellitus	9	25	0.011*
BMI>30 (n=35)			
Female /Male	10/1	21/3	0.769
Mean age (years)	48.09±.22	61.75±10.14	0.001*
Age ≥60/ <60	1/10	15/9	0.003*
Presence of Diabetes Mellitus (n)	2	22	0.000**
Age ≥60 (n=36)			
BMI>30	1	15	0.001*
Female/Male	13/0	20/3	0.174
Presence of Diabetes Mellitus	7	14	0.681
Age<60 (n=76)			
BMI>30	10	9	0.424
Female/Male	31/3	36/6	0.464
Presence of Diabetes Mellitus	2	15	0.002*
Presence of Diabetes Mellitus (n=38)			
BMI>30	2	22	0.004*
Female gender/ Male	9/0	25/4	0.239
Mean age (years)	63±9.13	59.89±0.70	0.438
Age ≥60/ <60	7/2	14/15	0.120

Discussion

In this study, the prevalence of obesity, age, gender differences and DM in mild and severe CTS patients was compared. Also the relationship between risk subgroups as female gender, BMI, age and DM was investigated. Link between risk factors and severity of CTS was aimed to be examined.

The mean age of the patients was 53.29±11.41 (min:29, max:80). The majority of cases (67.9%) were found in <60 age group. In literatüre, different age groups reported for risk (18,23,24). But when we examined subgroups obesity had more importance for disease severity in patients with age ≥60 and DM in contrary of Bland et al. They suggested that increased BMI is an independent risk factor for CTS in patients age< 63, but not in older ones. Patients over the age of 63 years have a different pattern of risk factors for CTS. This suggests that CTS in the elderly population may have different underlying pathogenetic mechanisms (25).

Females have formed the majority of the patients in accordance with the literatüre (18,23,24). Although female gender was an independent risk factor for CTS, we could not show its importance for severity of CTS. Female/male ratio was 8.3/1. There was not a difference of female/male distribution between mild and severe groups. In females, age and BMI did not differ between groups, whereas DM was found more frequent in severe group. In contrast, Moghtaderi et al found higher age and BMI in females (23). Becker et al found obesity more frequent in females, but males tended to have more severe lesions (11). In opposite, Nathan et al. found significantly increased BMI in females (16). In males, we did not find a significant risk factor of which we investigated. However, Werner et al. have shown the obesity as a stronger risk factor among males (6). In a manner consistent with our findings, Becker et al founde DM as a significant risk factor among females (11). A relationship between obesity and CTS has been reported (10,16). In the study, BMI was 25 and 29.9 kg/m^2 (overweight) in most of the patients (61.6%), there was not a significant difference for BMI between mild and severe groups. Werner et al. found that only 16% of underweight and 39% of the obese patients were diagnosed with CTS. Obese ones 2.5 times as likely to have the diagnosis of CTS compared to a group of slender individuals (26). Radecki reported that increased BMI was related prolongation of median latencies (27). Nordstrom et al. concluded a strong correlation between BMI and CTS (28). The accumulation of fat tissue in the carpal canal supposed to increase the hydrostatic pressure, and synovial thickening seems to be compressing the median nerve in obese people through the canal (29,30). Improvement of symptoms with decompression implies the ischemic components secondary to nerve compression (30). We could not find a significant difference for obesity between mild and severe CTS groups. In a histopathological study, an inverse correlation was found between BMI and thickening of the transverse carpal ligament, however, no correlation was observed between BMI and the degree of edema or fibrosis within the tenosynovium (31). In 35 patients with BMI>30 we did not find a gender difference between mild and severe groups. In obese patients, however, mean age, number of the patients with age ≥60 and DM were significantly different between groups.

Findings of the study confirm that DM is a risk factor for severity of CTS. DM was also found as a risk factor in female patients and patients with age <60. Seror et al. reported that obesity prevalence was increased in both idiopathic and DM patients in comparsion with general population (24). In opposite, Becker et al. disputed that DM might be a weak risk factor (11).

As a conclusion, this study demonstrated that presence of DM increases the severity of CTS in females, obese ones, under the age of 60 years. Obesity increases the severity of CTS in patients with DM, over the age of 60 years. A prospective study with DM, obese patients and healthy controls with larger groups could clarify the effect of risk factors for severity of CTS.The authors have declared that no competing interest exists.

References

1. Boz C, Ozmenoglu M, Altunayoglu V, Velioglu S, Alioglu Z. Individual risk factors for carpal tunnel syndrome: an evaluation of body mass index, wrist index and hand anthropometric measurements. Clin Neurol Neurosurg 2004;106(4):294-9.
2. Kouyoumdjian JA, Zanetta DM, Morita MP. Evaluation of age, body mass index, and wrist index as risk factors for carpal tunnel syndrome severity. Muscle Nerve 2002;25(1):93-7.
3. Geoghegan JM, Clark DI, Bainbridge LC, Smith C, Hubbard R. Risk factors in carpal tunnel syndrome. J Hand Surg Br 2004;29(4):315-20.
4. Nordstrom DL, Vierkant RA, DeStefano F, Layde PM. Risk factors for carpal tunnel syndrome in general population. Occup Environ Med 1997;54(10):734-40.
5. Padua L, Lo Monaco M, Gregori B, Valente EM, Padua R, Tonali P. Neurophysiological classifica

tion and sensitivity in 500 carpal tunnel syndrome hands. Acta Neurol Scand 1997;96(4):211-7.
6. Mondelli M, Giannini F, Giacchi M. Carpal tunnel syndrome incidence in a general population. Neurology 2002;58(2):289-94.
7. Nora DB, Becker J, Ehlers JA, Gomes I. Clinical features of 1039 patients with neurophysiological diagnosis of carpal tunnel syndrome. Clin Neurol Neurosurg 2004;107(1):64-9.
8. Palumbo CF, Szabo RM, Olmsted SL. The effects of hypothyroidism and thyroid replacement on the development of carpal tunnel syndrome. J Hand Surg Am 2000;25(4):734-9.
9. Werner RA, Jacobson JA, Jamadar DA. Inf luence of body mass index on median nerve function, carpal canal pressure, and cross sectional are a of the median nerve. Muscle Nerve 2004;30(4):481-5.
10. Werner RA, Andary M. Carpal tunnel syndrome: pathophysiology and clinical neurophysiology. Clin Neurophysiol 2002;113(9):1373-81.
11. Becker J, Nora DB, Gomes I, Stringari FF, Seitensus R, Panosso JS, et al. An evaluation of gender, obesity, age and diabetes mellitus as risk factors for carpal tunnel syndrome. Clin Neurophysiol 2002;113(9):1429-34.
12. Nathan PA, Meadows KD, Istvan JA. Predictors of carpal tunnel syndrome: an11-year study of industrial workers. J Hand Surg 2002;27(4):644–51.
13. Wieslander G, Norback D, Gothe CJ, L Juhlin. Carpal tunnel syndrome (CTS) and exposure to vibration, repetitive wrist movements, and heavy manual work: acase-referent study. Occup Environ Med 1989;46(1):43-7.
14. de Krom MC, Kester AD, Knipschild PG, Spaans F. Risk factors for carpal tunnel syndrome. Am J Epidemiol 1990;132(6):1102–10.
15. Vessey MP, Villard-Mackintosh L, Yeates D. Epidemiology of carpal tunnel syn-drome in women of childbearing age. Findings in a large cohort study. Int JEpidemiol 1990;19(3):655-9.
16. Nathan PA, Keniston RC, Myers LD, Meadows KD. Obesity as a risk factor for slow-ing of sensory conduction of the median nerve in industry. A cross-sectionaland longitudinal study involving 429 workers. J Occup Med 1992;34(4):379-83.
17. Leclerc A, Franchi P, Cristofari MF, Delemotte B, Mereau P, Teyssier-Cotte C, et al. Carpal tunnel syndrome and workorganisation in repetitive work: a cross sectional study in France. Study Groupon Repetitive Work. Occup Environ Med 1998;55(3):180-7.
18. Bland JD. The relationship of obesity, age, and carpal tunnel syndrome: morecomplex than was thought? Muscle Nerve 2005;32(4):527-32.
19. Chammas M, Bousquet P, Renard E, Poirier JL, Jaffiol C, Allieu Y. Dupuytren's disease, carpal tunnel syndrome, trigger finger, and diabetes mellitus. J Hand Surg 1995;20(1):109‑14.
20. Comi G, Lozza L, Galardi G, Ghilardi MF, Medaglini S, Canal N. Presence of carpal tunnel syndrome in diabetics: Effect of age, sex, diabetes duration and polyneuropathy. Acta Diabetol Lat 1985;22(3):259‑62.
21. Özcan TA, Özcan H, Işık HS. Carpal Tunnel Syndrome: Relationship Between Occupational Risk Factors and Nondominant Hand. Turkiye Klinikleri J Med Sci 2013;33(2):396-400.
22. Obesity: preventing and managing the global epidemic. Report of aWHO consultation. World Health Organization technical report series. 2000; 894:i-xii,1-253.
23. Moghtaderi A, Izadi S, Sharafadinzadeh N. An evaluation of gender, body mass index, wrist circumference and wrist ratio as independent risk factors for carpal tunnel syndrome. Acta Neurol Scand 2005;112(6):375-9.
24. Seror P, Seror R. Prevalence of obesity and obesity as a risk factor in patients with severe mediannerve lesion at the wrist. Joint Bone Spine 2013; 80(6): 632-7.
25. Kouyoumdjian JA, Morita MD, Rocha PR, Miranda RC, Gouveia GM. Body mass index and carpal tunnel syndrome. Arq Neuropsiquiatr 2000; 58(2A):252-6.
26. Werner RA, Albers JW, Franzblau A, Armstrong TJ. The relationship between body mass index and the diagnosis of carpal tunnel syndrome. Muscle Nerve 1994;17(6):632-6.
27. Radecki P. Variability in the median and ulnar nerve latencies: implications for diagnosing entrapment. J Occup Environ Med 1995;37(11): 1293-9.
28. Nordstrom DL, Vierkant RA, De Stefano F, Layde PM. Risk factors for carpal tunnel syndrome in general population. Occup Environ Med 1997; 54(10):734-40.
29. Radecki P. Personal factors and blood volume movement in causation of median neuropathy at the carpal tunnel: a commentary. Am J Phys Rehabil 1996;75(3):235-8.
30. Werner R, Armstrong TJ, Bir C, Aylard MK. Intracarpal canal pressures: the role of finger, hand, wrist and forearm position. Clin Biomech 1997; 12(1):44-51.
31. Chell J, Stevens A, Davis TRC. Work practices and histopathological changes in the tenosynovium and flexor retinaculum in carpal tunnel syndrome in women. J Bone Joint Surg 1999;81(5): 868-70.

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