

## UTICAJ RADNOG OPTEREĆENJA NA RAZVOJ SINDROMA KARPALNOG TUNELA

ŽANI BANJANIN<sup>1</sup>, LJUBOMIR ŠORMAZ<sup>1</sup>, JADRANKA PEŠEVIĆ PAJČIN<sup>1</sup>, SNJEŽANA AMIDŽIĆ<sup>2</sup>

<sup>1</sup>JZU Dom zdravlja „Dr Mladen Stojanović“, Laktaši, Bosna i Hercegovina

<sup>2</sup>student II ciklusa, Medicinski fakultet, Univerzitet u Banjoj Luci, Bosna i Hercegovina

### Korespondencija:

Dr Žani Banjanin  
zana\_banjanin@yahoo.com  
+387 66 711 551

**Apstrakt:** Sindrom karpalnog tunela (CTS) predstavlja najčešću kompresivnu neuropatiju koja zahvata od 3 do 6% osoba u generalnoj populaciji. Predstavlja jedan od najznačajnijih zdravstvenih i finansijskih problema u radnoj populaciji. Našim istraživanjem obuhvaćeno je 98 ispitanika (77 žena ili 78,6% i 21 muškarac 21 ili 21,4%). Ispitanici su bili starosti 52 ± 11,1 godina. Ispitanici su bili zaposleni u privrednim sektorima na poslovima visokog rizika za nastanak CTS: poljoprivreda i stočarstvo, uslužne djelatnosti, građevinarstvo, prehrambena proizvodnja i javna uprava. Ispitanicima je urađen detaljan fizikalni pregled i EMNG radi postavljanja dijagnoze i stepena neurogenog oštećenja. Utvrđeno je da su prisutna hipotrofija i slabost (MMT) mišića tenara, kao i pozitivan Phalenov znak pokazali statistički visoko značajnu razliku u odnosu na stepen neurogene lezije.

**Ključne riječi:** sindrom karpalnog kanala, radno opterećenje, fizikalni pregled, EMNG.

### Uvod

Kompresivne neuropatije po definiciji predstavljaju stanje disproporcije između zapremine perifernog nerva i prostora kroz koji nerv u ekstremitetu prolazi. Karpalni tunel sindrom (CTS) predstavlja grupu simptoma i znakova uzrokovanih iritacijom i kompresijom nerva medijanusa u predjelu karpalnog tunela. Predstavlja najučestaliju kompresivnu fokalnu neuropatiju u kliničkoj praksi sa prevalencom od 1,3-16% (Aroori i Spence, 2008; Atroshi, Englund, Turkiewicz, Tägil i Petersson, 2011). Žene češće obolijevaju od muškaraca (3:1), a najveća učestalost pojavljivanja CTS je kod radno sposobnog stanovništva između 45. i 60. godine života (Aroori i Spence, 2008).

Prvi put je 1947. godine ustanovljena povezanost CTS sa specifičnim poslovima koji zahtijevaju pojačanu

## WORKLOAD IMPACT ON CARPAL TUNNEL SYNDROME GROWTH

ŽANI BANJANIN<sup>1</sup>, LJUBOMIR ŠORMAZ<sup>1</sup>, JADRANKA PEŠEVIĆ PAJČIN<sup>1</sup>, SNJEŽANA AMIDŽIĆ<sup>2</sup>

<sup>1</sup>Health Centre “Dr Mladen Stojanovic”, Laktaši, Bosnia and Herzegovina

<sup>2</sup>Student of Second Cycle of Studies, Faculty of Medicine, University of Banja Luka, Bosnia and Herzegovina

### Correspondence:

Dr Žani Banjanin  
zana\_banjanin@yahoo.com  
+387 66 711 551

**Abstract:** Carpal tunnel syndrome (CTS) is the most common compression neuropathy that affects 3 to 6% of people in the general population. It represents one of the most significant health and financial problems in the working population. Our study included 98 patients. The women were 77 (78.6%) and men 21 (21.4%). Age has averaged 52 ± 11.1 years. The respondents were employed in sectors of the economy in jobs at high risk for the occurrence of CTS: agriculture and livestock breeding, services, construction, food production and public administration. The respondents were subject of a detailed physical examination and electromyoneurographic tests (EMG) to confirm the diagnosis and level of neurogenic damage. It was found that the hypotrophy and weakness of thenar muscle and a positive Phalen's sign showed statistically highly significant difference in relation to the level of neurogenic lesions.

**Keywords:** Carpal tunnel syndrome, workload, physical examination, EMG.

### INTRODUCTION

The compressive neuropathies, by definition, represent the state of disproportion between the volume of the peripheral nerve and the space through which a nerve in extremities passes. Carpal tunnel syndrome (CTS) is a group of signs and symptoms caused by irritation of the nerve and compressing medianum in the area of the carpal tunnel.

The most common compressive focal neuropathy in clinical practice has a prevalence of 1.3 to 16% (Aroori & Spence, 2008; Atroshi, Englund, Turkiewicz, Tägil, & Petersson, 2011). Women suffer more often than men (3:1), and the highest incidence of CTS is the working-age population between 45 and 60 years of age (Aroori & Spence, 2008).

upotrebu zgloba šake (Brian, Wright i Wilkinson, 1947). Incidenca CTS je povećana kod osoba sa nervnom disfunkcijom (hereditarne neuropatije), pridruženim oboljenjima (dijabetes, hipotiroidizam, sistemska bolest vezivnog tkiva, gojaznost, bubrežna oboljenja), u trudnoći, kod dugotrajnog uzimanja hormonskih kontraceptiva, kod mehaničkog nadražaja (loše srasle frakture u predelu ručnog zgloba, gangliomi)-(Armstrong, Dale, Franzblaun i Evanoff, 2008).

Biološki faktori, kao što su genetska predispozicija i antropometrijski parametri su značajnije povezani sa nastankom CTS u odnosu na faktore radne sredine i okruženja.

U većini slučajeva se ne može identifikovati neki ključni etiopatogenetski uzročnik, pa se govori o idiopatskom sindromu, odnosno o stanju koje je posljedica sindroma prenaprezanja (Crnković, Bilić i Kolundžić, 2008).

Određene profesionalne aktivnosti nose povećan rizik od CTS. Studija Yves Roouelaurs et al., iz 2008 (prema Jagga, Lehri i Verma, 2011) daje visoko kvalitetne informacije o radu udruženja CTS. Uočena je visoka prevalenca u proizvodnji (42-93% za oba pola), građevinarstvu (66% muškaraca), uslužnim djelatnostima (66% za žene) i u trgovini i ekonomskom sektoru (49% za žene).

Brza i pouzdana dijagnoza postavlja se na osnovu karakterističnih anamnestičkih podataka, kliničkog pregleda i elektrodijagnostičkog ispitivanja, a kao dopunske analize mogu poslužiti rentgen, ultrazvuk, nuklearna magnetna rezonanca (Keith i sar., 2014).

Pacijenti se žale na bolove sa osećajem žarenja i trnjenja, u inervacionom području medijalnog nerva, koji dominiraju tokom noći. Manje uobičajeni simptomi su osjećaj nespretnosti i slabost koji upućuju na pogoršanje kliničke slike. Tegobe se često javljaju obostrano, a nešto češće ili izraženije su na dominantnoj ruci (Keith i sar., 2014).

Od kliničkih testovi za postavljanje dijagnoze koriste se: Tinelov znak, Falenov test, dijagram šake po Katzu i drugi (Katz i Simmons, 2002). Pregledom (inspekcijom) utvrđujemo prisutnu hipotrofija mišića tenara, amanelnim mišićnim testom se procjenjuje slabost mišića tenara inervisanih medijalnim nervom (Ibrahim, Khan, Goddard i Smitham, 2012). Elektromioneurografsko ispitivanje (EMNG) kao dijagnostička metoda izbora, koristi se pri postavljanju dijagnoze ovog senzomotornog ispada (Robinson, 2007). Za dijagnostiku je od izuzetnog značaja prepoznavanje kliničke slike koja je vrlo šarolika i prije svega ovisi o trajanju i jačini pritiska na nerv. Smetnje senzibiliteta su prvi i najstalniji simptom i po-

It was first determined in 1947 that the CTS is connected with specific jobs that require increased use of wrist (Brian, Wright & Wilkinson, 1947). The incidence of CTS is increased in people with nerve dysfunction (hereditary neuropathy), comorbid diseases (diabetes, hypothyroidism, systemic connective tissue disorder, obesity, renal disease), during pregnancy, with long-term use of hormonal contraceptives, the mechanical irritation (poorly coalesced fractures in the wrist, gangliomi) (Armstrong, Dale, Franzblaun & Evanoff, 2008).

The biological factors, such as genetic predisposition and anthropometric parameters were significantly associated with the development of CTS in relation to the factors of the environment and the environment. In most cases you cannot identify any key etiopathogenic cause, and there is a possibility that it is about idiopathic syndrome or a condition that is the result of overuse injuries (Crnković, Bilić & Kolundžić, 2008).

Certain professional activities carry an increased risk of CTS. Study Yves Roouelaurs et al. from 2008 (see Jagga, Lehri & Verma, 2011) provides a high-quality information on the activities of the association CTS. There was a high prevalence in production (42-93% for both sexes), construction (66% of men), services (66% for women) and in the trade and economic sector (49% for women). Fast and reliable diagnosis set-up on the basis of characteristic anamnesis, clinical examination and electrical diagnostic tests, as additional analysis may be used X-ray, ultrasound, magnetic resonance imaging (Keith et al, 2014).

The patients complain of pain with a burning sensation and numbness in innervation territory of the median nerve, which dominates during the night. Less common symptoms include a feeling of clumsiness and weakness pointing to worsening of the clinical picture. The problems often occur on both sides or are more pronounced on the dominant hand (Keith et al, 2014). For the purpose of diagnosis from the clinical tests we used: Tinel's sign, Falen's test, hand diagram by Katz et al (Katz et al, 2002). A review (inspection) determined the present weakness of thenar muscle, and a manual muscle test assesses weakness of thenar muscles innervated by median nerve (Ibrahim et al, 2012). Electromyoneurographic testing (EMG) as a diagnostic method of choice is used in the diagnosis of sensorimotor failure (Robinson, 2007).

For diagnosis it is crucial to recognize the clinical picture, which is very diverse and primarily depends on the duration and severity of the pressure on the nerve. Sensitivity disorders are the first and most persistent

javljaju se u 80% oboljelih (Crnković, Bilić i Kolundžić, 2008; Phalen, 1972). Česti simptomi su parestezije i bol koja je izraženija noću. Motoričke smetnje u inervacijom području nerva medianusa nastaju u bolesnika s dugotrajnom intenzivnom kompresijom nerva, a smetnje motiliteta očituju se kao nespretnost i nesigurnost pokreta te hvatanja prstima i palcem. Hipotrofija radijalne grupe tenarnih mišića pojavljuje se u oko 40% bolesnika sa sindromom karpalnog kanala (Crnković, Bilić i Kolundžić, 2008).

Klinička dijagnostika se bazira na prepoznavanju tri osnovna simptoma: poremećaj senzibiliteta, poremećaj motiliteta i atrofija mišića šake, Odlučujuća je neurofiziološka obrada nerva pomoću koje se može odrediti tačno mjesto kompresije. Često, težina simptoma i znakova CTS nije u korelaciji sa stepenom oštećenja nerva. Na pogoršanje simptoma CTS utiče promjena položaja gornjih ekstremiteta pri određenim aktivnostima. Bilateralni CTS je često prva prezentacija kod 65% pacijenata, a predstavlja loš prognostički faktor (Ashworth, 2011).

Veoma je bitna pravovremena dijagnoza i liječenje CTS, jer duže trajanje bolesti i dugotrajnija kompresija, osim subjektivnih tegoba, dovode do težeg oštećenja nerva i smanjuju izgleda

Uspješnosti liječenja. To rezultira smanjenjem radne sposobnosti te individualnim i širim društvenim i ekonomskim posljedicama (Fowler, Gaughan i Ilyas, 2011; Ibrahim i sar., 2012)

Cilj našeg rada bio je da se ustanovi uticaj radnog opterećenja na razvoj CTS kao i da se utvrdi postojanje i stepen korelacije kliničkog nalaza i težine neurogene lezije dobijene elektromioneurografskim (EMNG) ispitivanjem pacijenata.

## ISPITANICI I METODE

Izvršena je retrospektivna analiza podataka iz elektronskih kartona pacijenata liječenih u periodu od septembra 2013. godine do marta 2015. godine u našem CBR centru. Uzorak je obuhvatio 98 pacijenata koji su u navedenom periodu liječeni pod dijagnozom sindroma karpalnog kanala.

Ispitanici su bili zaposleni u privrednim sektorima na poslovima visokog rizika za razvoj CTS: poljoprivrede i stočarstvo, uslužne djelatnosti, građevinarstvo, prehrambena proizvodnja i javna uprava.

Kriterijumi za uključivanje u studiju:

1. najmanje pet godina rada na određenom radnom mjestu prije dijagnostikovanja CTS,
2. bez prethodne terapije za CTS (fizična, operativna, injekcije kortikosteroida),

symptoms and occur in 80% of patients (Crnkovic et al, 2008; Phalen, 1972). The common symptoms as paresthesias and pain are more pronounced at night. The motor disorders in the area of median nerve innervation occur in patients with a prolonged and intense compression of the nerve, and motility disorders are manifested as the awkwardness and uncertainty of movement and capturing with fingers and thumb. The hypotrophy of thenar muscles occurs in approximately 40% of patients with carpal tunnel syndrome (Crnkovic et al, 2008).

The clinical diagnosis is based on identifying three main symptoms: disturbance of sensibility, motility disorder and the muscle atrophy of hands. Crucial method is neurophysiological processing of the nerve which helps to determine the exact location of the compression. Often, the severity of symptoms and signs of CTS are not correlated with the degree of damage of the nerve. The worsening of the symptoms of CTS is affected by the change of the position of the upper extremities in certain activities. The bilateral CTS is often the first presentation of the disease in 65% of patients, and it is a poor prognostic factor (Ashworth, 2011). Very important is timely diagnosis and the treatment of CTS, because the longer duration of the disease and prolonged compression, in addition to subjective problems, will lead to severe nerve damage and reduce the prospects of the treatment success. This result in reduction of working capacity and has individual and wider social and economic consequences (Fowler, Gaughan & Ilyas, 2011; Abraham et al, 2012).

The aim of our study was to determine the effect of the workload on the development of CTS, as well as to determine the existence and the degree of correlation of clinical findings and severity of neurogenic lesions obtained by the electromyoneurography (EMG) examination of patients.

## PATIENTS AND METHODS

We analysed electronic records of patients treated between september 2013 and march 2015 in our CBR center. The sample included 98 patients with carpal tunnel syndrome. The respondents were employed in the sectors of the economy in jobs at high risk for developing the CTS: the agriculture and cattle breeding, services, construction, food production and public administration.

Criteria for inclusion in the study:

1. at least five years of work at the specific workplace before the diagnosis of CTS,
2. without therapy for CTS (physical, operational, injections of corticosteroids),

3. urađeno EMNG ispitivanje radi potvrde dijagnoze CTS.

Iz studije su isključeni pacijenti koji su imali operaciju i/ili povredu na gornjim ekstremitetima. U EMNG pregledu su ispitivani denervacioni potencijali i interferentni obrazac. Od dijagnostičkih parametara praćene su: motorna i senzitivna brzina (MB, SB), njihove terminalne letence (MTL, STL), i elektromiografska (EMG) spontana aktivnost. Pod normalnim vrijednostima za ove parametre podrazumijevale su se sljedeće vrijednosti: MTL= 4,2ms, MB  $\geq$ 50m/s, SB  $\geq$ 50m/s. Stepen neurogenog oštećenja u odnosu na vrijednost senzitivne i motorne TL, odnosno sniženje senzitivne i motorne brzine podijelili smo na :

1. blag CTS: granična vrijednost motorne TL (4,2ms), lako sniženje senzitivne brzine, bez redukcije inervacionog uzorka,
2. umjeren CTS: vrijednost motorne TL u opsegu od 4,2ms – 5,5ms, sniženje senzitivne brzine, EMG nalaz - prisustvo neuropatskih akcionih potencijala, blaga do umjerena redukcija inervacionog uzorka,
3. težak CTS: vrijednost motorne TL preko 6ms, znatno sniženje senzitivne brzine do nemjerljivih vrijednosti, EMG nalaz - prisustvo neuropatskih akcionih potencijala, jaka redukcija inervacionog uzorka.

Podaci su analizirani savremenim metodama deskriptivne i analitičke statistike uz računarsku podršku i softverski paket SPSS 12,0. Pod statističkom značajnošću podrazumijevala se vrijednost  $p < 0,05$ .

## REZULTATI

Analizirano je 98 ispitanika. Žena je bilo 77 (78,6%) a muškaraca 21 (21,4%). Zastupljenost žena bila je statistički značajno veća u odnosu na zastupljenost muškaraca ( $p < 0,01$ ).

Starost ispitanika iznosila je prosječno  $52 \pm 11,1$  godina.

U vrijeme ispitivanja, 63% žena i 87% muškaraca oboljelih od CTS je bilo zaposleno, a 81% žena i 97% muškaraca je imalo najmanje 5 godina radnog staža u ispitivanim privrednim sektorima prije dijagnostikovanja bolesti.

Procentualna zastupljenost ispitanika u određenim privrednim djelatnostima, prikazana je na *Slici 1*.

3. EMG test conducted to confirm the diagnosis of CTS.

This study excluded patients who had surgery and/or injury of the upper extremities. We conducted the EMG examination to check the denervation potentials and interference pattern. Out of the diagnostic parameters we monitored the motor and sensitive velocity (MB, SB), their terminal latencies (MTL, STL), and electromyographic (EMG) spontaneous activity. Under normal values for these drive parameters implied the following: MTL = 4.2 ms, MB  $\geq$  50 m / s, SB  $\geq$  50 m / s.

The degree of neurogenic damage in relation to the value of the sensitive and motor TL, and reduced sensory and motor speed we divided to:

1. mild CTS limit value motor TL (4.2 ms), light sensitive lowering speed, without reduction of innervated sample,
2. moderate CTS: value chain TL in the range of 4.2 ms - 5.5 ms, lowering speed sensitive, EMG finding - the presence of neuropathic action potentials, mild to moderate reduction of innervated sample,
3. heavy CTS: value chain TL than 6 ms, significantly lowering the speed sensitive to the immeasurable value, EMG finding - the presence of neuropathic action potentials, strong reduction of innervated sample.

Data were analyzed by contemporary methods of descriptive and analytical statistics with the computer support and software package SPSS 12.0. Under the statistical significance implied value of  $p < 0.05$ .

## RESULTS

We analyzed 98 patients, 77 (78.6%) women and 21 (21.4%) men. The representation of women was significantly higher than the representation of men ( $p < 0.01$ ).

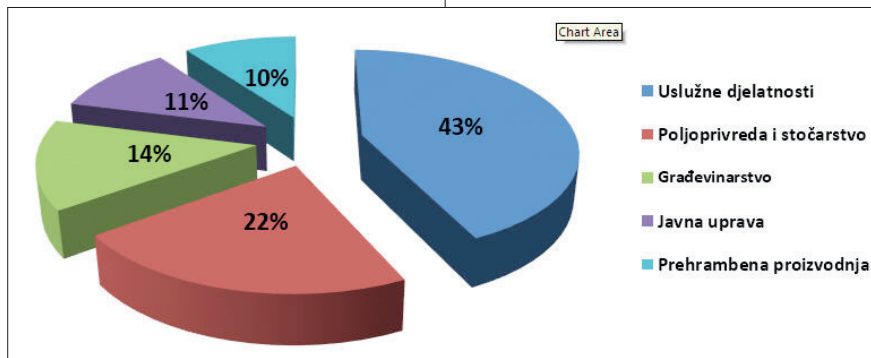
The average age was  $52 \pm 11.1$  years. For men, the average age was  $53.4 \pm 14.2$  years and for women  $55.6 \pm 11.3$  years.

During the tests, 63% of women and 87% of men suffering from CTS were employed. 81% of women and 97% of men had at least 5 years of experience in the monitored sectors of the economy, prior to diagnosis of the disease.

The percentage of respondents in certain economic activities is shown in *Figure 1*.



**Slika 1.** Procentualna zastupljenost ispitanika u privrednim djelatnostima



**Figure 1.** Percentage of respondents in economic activities

Uočavamo da je najviše ispitanika bilo u uslužnim djelatnostima (43%), a najmanje u prehrambenoj proizvodnji (10%).

U toku EMNG ispitivanja, ustanovljeno je da je najveća zastupljenost CTS bila na desnoj ruci ispitanika (47,3%), nešto manja zastupljenost na obe ruke (43%) i značajno manja zastupljenost na lijevoj ruci (9,7%). Ovaj rezultat ima visok statistički značaj ( $X^2 = p < 0,01$ )

Analizirajući odnos između kliničkog nalaza i stepena neurogene lezije, dobijen EMNG analizom, utvrdili smo da su svi klinički nalazi pokazali statistički visoko značajnu razliku u odnosu na stepen neurogene lezije (Tabela 1).

The most of the respondents were employed in the service sector (43%) and least in the food production (10%). During the EMG test, it was found that the greatest incidence of CTS was on the right hand of the respondents (47.3%), slightly lower representation in both arms (43%) and significantly less representation on the left arm (9.7%). This result has a high statistical significance ( $X^2 = p < 0.01$ ). Analyzing the relationship between clinical findings and the degree of neurogenic lesions, obtained by EMG analysis, we found that all of the clinical results showed a highly statistically significant difference in relation to the level of neurogenic lesion (Table 1).

**Tabela 1.** Odnos između kliničkog nalaza i stepena neurogene lezije

**Table 1.** The relationship between the clinical findings and the degree of neurogenic lesions

		Stepen neurogene lezije (EMNG) / The degree of neurogenic lesions (EMG)						
		Blaga / Mild		Umjerena / Moderate		Teška / Severe		
		N	%	N	%	N	%	
Phalenov znak / Phalen sign	-	18	90	13	30.95	0	0	
	+	2	10	29	69.05	36	100	
Klinički nalaz / Clinical finding	Hipotrofija / Hypotrophy	Ne	20	100	31	73.8	10	27.77
		Da	0	0	11	26.2	26	72.23
Slabost (MMT) / Weakness (MMT)	Ne	20	100	25	59.52	8	22.22	
	Da	0	0	17	40.48	28	77.78	
Ukupno / Total		20		42		36	98	

**DISKUSIJA**

Prosječna starost naših ispitanika, bila je  $52 \pm 11,1$  godina što se slaže sa drugim istraživanjima koja su pokazala da je najveća incidenca pojave CTS između 55. i 60. godine života (Ansari, Adelmanesh, Naghdi i Mousavi, 2008).

Bez obzira na etiologiju nastanka, najveća procentualna zastupljenost sindroma karpalnog tunela kod ispitanika

**DISCUSSION**

The average age of our patients was  $52 \pm 11.1$  years, which is consistent with other studies that has shown that the highest incidence of CTS is between the age of 55 and 60 (Ansari, Adelmanesh, Naghdi & Mousavi, 2008).

Regardless of the etiology, the greatest percentages of carpal tunnel syndrome among the respondents, was on

ka, bila je na dominantnoj, desnoj ruci (47,3%), nešto niža zastupljenost na obe ruke (43%) i najniža na lijevoj ruci (9,7%). Slične rezultate su dobili i Galea, Gatt i Sciberras (2007) i Nora, Becker, Ehlers i Gomes (2004).

Naši rezultati nakon ispitivanja odnosa stepena neurogene lezije i fizikalnog nalaza, ukazuju na statistički visoko značajnu razliku u odnosu praćenih parametara. U svom radu Nora i sar. (2004) ispitivali su odnos stepena neurogene lezije, subjektivnih tegoba i kliničkog nalaza kod 1039 pacijenta sa CTS i dobili rezultate slične našim.

Naša saznanja o povećanom riziku od razvoja CTS u navedenim privrednim djelatnostima su u skladu sa epidemiološkim studijama koje je 2001. godine sproveo NRC (National Research Council, Washington). Slične rezultate su imali i Galea, Gatt i Sciberras (2007)

Uprkos značaju pozitivnog uticaja na javno zdravstvo, vrlo malo je objavljenih radova na temu povećanog rizika nastanka CTS kod osoba izloženih radnom opterećenju kod nekih zanimanja (Punnett i sar., 2004; Galea, Gatt i Sciberras, 2007).

Rad u uslužnim djelatnostima sa značajnijom zastupljenošću žena (75%), nego muškaraca (21%) povećava i rizik oboljevanja od sindroma karpalnog kanala kod žena i istovremeno smanjuje rizik oboljevanja kod muškaraca.

Zastupljenost muškaraca (12%) u građevinskim djelatnostima, koja je mnogo veća nego zastupljenost žena (2%), povećava rizik oboljevanja kod muškaraca.

U prehrambenom sektoru zastupljenost oba pola (žene 6 %, muškarci 4%) bila je slična.

To potvrđuje činjenicu da interventni preventivni programi moraju uzeti u obzir ne samo razine rizika u pojedinim djelatnostima nego i brojčanu i polnu zastupljenost radnika. Naši rezultati ukazuju na činjenicu da interventni program mjera treba fokusirati na prehrambenu industriju (za oba spola), građevinski sektor (za muškarce) i na uslužne djelatnosti za žene (npr blagajnice, frizeri, ugostiteljski radnici...) - Palmer, Reading, Calnan i Coggon (2008).

## ZAKLJUČAK

Zbog svoje visoke osjetljivosti i specifičnosti, EMNG ispitivanje ostaje zlatni standard u dijagnostici sindroma karpalnog kanala. Ova metoda pruža preciznu i ranu dijagnozu CTS i pomaže u izboru terapijskog tretmana.

Uz pretpostavku da ostali faktori rizika ostaju nepromijenjeni i da postoji uzročna veza između izlaganja radu i CTS u visokorizičnim zanimanjima, htjeli smo otkriti udio CTS slučajeva koji bi mogli biti spriječeni nakon smanjenja rizika od njihovog nastanka na radnom mjestu. Takve informacije pružaju mogućnost procjene maksimalnog potencijalnog uticaja programa prevencije CTS na radnom

right (dominant) hand (47.3%), slightly lower representation on both hands (43%) and lowest on the left hand (9.7%). Similar results were obtained by Galea, Gatt & Sciberras (2007) and Nora, Becker, Ehlers & Gomes (2004).

Our results after testing the level of relations of neurogenic lesions and physical findings, are showing statistically significant difference compared to the monitored parameters. In his work, Nora et al. (2004) examined the relationship of the degree of neurogenic lesions, subjective complaints and clinical findings in 1039 patients with CTS and get results similar to ours. Our findings of an increased risk of developing CTS in these economic activities are in line with the epidemiological study conducted by the NRC (National Research Council, Washington), 2001. Similar results had Galea et al. (2007). Despite the importance of the positive impact on public health, very few have published papers on the subject of the increased risk of CTS in persons exposed to the workload in some occupations (Punnett et al., 2004; Galea et al., 2007).

Working in the service industry with significant representation of women (75%) than men (21%) increases the risk of developing carpal tunnel syndrome in women and at the same time it reduces the risk of the disease in men. Representation of men (12%) in the construction sector, which is much higher than the proportion of women (2%) increases the risk in men.

This is confirmed by the fact that emergency prevention programs must take into account not only the level of risk in specific activities, but also a number and the gender representation of the employees. Our results indicate that intervention programs of measures should focus on the food industry (for both sexes), construction sector (for men) and service activities for women (eg cashiers, hairdressers, catering workers ...) (Palmer et al., 2008). In the food sector we found similar results for both genders (women 6%, men 4%).

## CONCLUSIONS

Because of its high sensitivity and specificity, EMG testing remains the gold standard in the diagnosis of carpal kanala. This method provides an accurate and early diagnosis of CTS and helps in the selection of therapeutic treatment.

Assuming that other risk factors remain unchanged and that there is a causal relationship between exposure to work and CTS in high-risk occupations, we wanted to discover the share of CTS cases that could be prevented after the reduction of the risk of their occurrence in the workplace. Such information provides the ability to estimate the maximum potential impact of CTS prevention

mjestu. Ovo bi bilo posebno korisno za politiku preventivnih programa i za određivanje koji sektori ili zanimanja zahtijevaju intervenciju. U ovoj studiji htjeli smo procijeniti zastupljenost CTS u odnosu na glavne industrijske sektore i radne kategorije i na taj način ukazati na zanimanja sa visokim rizikom od razvoja CTS.

programs in the workplace. This would be particularly useful for policy and prevention programs to determine which sectors or occupations are requiring intervention. In this study, we wanted to assess the presence of CTS in relation to the main industrial sectors and occupational categories, and thus indicate the occupations with high risk of developing CTS.

## LITERATURA / REFERENCES

- Ansari, N. N., Adelmanesh, F., Naghdi, S., & Mousavi, S. (2008). The relationship between symptoms, clinical tests and nerve conduction study findings in carpal tunnel syndrome. *Electromyography and clinical neurophysiology*, 49(1), 53-57.
- Armstrong, T., Dale, A. M., Franzblau, A., & Evanoff, B. A. (2008). Risk factors for carpal tunnel syndrome and median neuropathy in a working population. *Journal of Occupational and Environmental Medicine*, 50(12), 1355-1364.
- Aroori, S., & Spence RA. (2008). Carpal tunnel syndrome. *Ulster Med. J.* 77, 6-17.
- Ashworth NL. (2011). Carpal tunnel syndrome. *Clinical Evidence* 10, 1114.
- Atroshi, I., Englund, M., Turkiewicz, A., Tägil, M., & Petersson, I. F. (2011). Incidence of physician-diagnosed carpal tunnel syndrome in the general population. *Archives of internal medicine*, 171(10), 941-954.
- Brian, W. R., Wright, A. D., & Wilkinson, M. (1947). Spontaneous compression of both median nerves in the carpal tunnel. *Lancet*, 1, 277-282.
- Crnković, T., Bilić, R., & Kolundžić, R. (2008). Sindrom karpalnog tunela-suvremena dijagnostika i liječenje. *Medica Jadertina*, 38(3-4), 77-84. [In Croatian]
- Fowler, J. R., Gaughan, J. P., & Ilyas, A. M. (2011). The sensitivity and specificity of ultrasound for the diagnosis of carpal tunnel syndrome: a meta-analysis. *Clinical Orthopaedics and Related Research*, 469(4), 1089-1094.
- Galea, L. A., Gatt, R., & Sciberras, C. (2007). Hand and wrist configurations in patients with Carpal Tunnel Syndrome. *Malta Medical Journal Vol. 19*.
- Ibrahim, I., Khan, W. S., Goddard, N., & Smitham, P. (2012). Suppl 1: Carpal Tunnel Syndrome: A Review of the Recent Literature. *The Open Orthopaedics Journal*, 6, 69.
- Jagga, V., Lehri, A., & Verma, S. K. (2011). Occupation and its association with Carpal Tunnel syndrome-A Review.
- Katz, J. N., & Simmons, B. P. (2002). Clinical practice. Carpal tunnel syndrome. *The New England journal of medicine*, 346(23), 1807-1812.
- Keith, M.W., Masear, V., Chung, K.C., Maupin, K., Andary, M., Amadio, P.C., Watters, W.C. III., Haralson, R.H. III., Turkelson, C.M., Wies, J.L. (2014). American Academy of Orthopaedic Surgeons, Clinical Practice Guideline on diagnosis of carpal tunnel syndrome Retrieved.
- National Research Council & the National Academy of Sciences (2001). Musculoskeletal Disorders and the Workplace: Low back and Upper Extremity musculoskeletal disorders. *National Academy Press*.
- Nora, D. B., Becker, J., Ehlers, J. A., & Gomes, I. (2004). Clinical features of 1039 patients with neurophysiological diagnosis of carpal tunnel syndrome. *Clinical neurology and neurosurgery*, 107(1), 64-69.
- Palmer, K. T., Reading, I., Calnan, M., & Coggon, D. (2008). How common is repetitive strain injury?. *Occupational and environmental medicine*, 65(5), 331-335.
- Phalen, G. S. (1972). The Carpal-tunnel Syndrome: Clinical Evaluation of 598 Hands. *Clinical orthopaedics and related research*, 83, 29-40.
- Punnett, L., & Wegman, D. H. (2004). Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. *Journal of Electromyography and Kinesiology*, 14(1), 13-23.
- Robinson, L. R. (2007). Electrodiagnosis of carpal tunnel syndrome. *Physical medicine and rehabilitation clinics of North America*, 18(4), 733-746.
- Roquelaure, Y., Ha, C., Pelier-Cady, M. C., Nicolas, G., Descatha, A., Leclerc, A., & Imbernon, E. (2008). Work increases the incidence of carpal tunnel syndrome in the general population. *Muscle & Nerve*, 37(4), 477-482.

Primljen: 16. aprila 2015. / Received: April 16, 2015  
Izmjene primljene: 24. novembra 2015. / Changes received: November 24, 2015  
Prihvaćen: 26. novembra 2015. / Accepted: November 26, 2015