

Case-Control Study on Individual Risk Factors of Carpal Tunnel Syndrome in Bangladeshi Population

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Abstract

Original Research Article

Introduction: Carpal tunnel syndrome (CTS) is a symptomatic compression neuropathy of the median nerve at the level of the wrist, physiologically characterized by increased pressure within the carpal tunnel and a decreased function of the nerve at that level. With the prevalence estimated between 7% and 18% of the adult population, CTS is the most common entrapment neuropathy of the upper extremities. It is the most common neuro-compressive disease. **Objective:** To assess the individual risk factors of carpal tunnel syndrome in Bangladeshi population. **Materials and Methods:** The present case-control study was conducted at the Dept. of Neurology, Uttara Adhunik Medical College Hospital (UAMCH), Uttara, Dhaka, Bangladesh from January 2019 to December 2021. 3019 patients included in our study and who were diagnosed in the 84% of patients were aged 41-70 years both case and control groups. Both groups filled out a standardized questionnaire, and a standardized patient record was filled out by Neurology Department. In addition, participants with jobs involving lifting and carrying of loads were interviewed. The incidence of CTS in middle aged women was significantly higher than that in men. **Results:** In our study 3019 patients who were diagnosed in the 84% of patients were aged 41-70 years. Among these patients, there were 756 CTS patients aged 41-70 years without any other diseases which could cause numbness as the case group. Then there were 2263 non-CTS outpatients involved as the control group. The average BMI in case group was 22.79 ± 2.60 and 21.49 ± 5.03 in control group with significant difference ($P < 0.01$). The results showed that sex, age, smoking, wrist injury, diabetes mellitus, hypothyroidism and wrist working are all risk factors of CTS. Hypertension could be a protection factor of CTS in early phase but will increase the risk in a long-term high blood pressure. Smoking, alcohol and diabetes mellitus can be predictors of moderate and severe CTS. **Conclusion:** In conclusion, sex, age, smoking, wrist injury, diabetes mellitus, hypothyroidism and wrist working are all risk factors of CTS. Hypertension could be a protection factor of CTS in early phase but will raise the risk in a long-term high blood pressure. Smoking, alcohol and diabetes mellitus can be the predictors of moderate and severe CTS. Elder people are affected by the working factors compared to younger people.

Keywords: Carpal Tunnel Syndrome, Peripheral Nervous System Disease, Cumulative Trauma Disorder.

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INTRODUCTION

Carpal tunnel syndrome (CTS) is a symptomatic compression neuropathy of the median nerve at the level of the wrist, physiologically characterized by increased pressure within the carpal tunnel and a decreased function of the nerve at that level [1, 2]. With the prevalence estimated between 7% and 18% of the adult population [3], CTS is the most common entrapment neuropathy of the upper

extremities [4, 5]. It is the most common neuro-compressive disease. With the development of the modern life, the morbidity of CTS is also increased [6]. As a common disease, the study on etiology is very important in CTS, which can improve the life quality of patients with CTS. In the only report of the incidence of CTS in a general population [7], cases were not interviewed, and job title was the main occupational item abstracted from the medical records [8]. Carpal

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tunnel syndrome (CTS) is one of the most common compressive, canalicular neuropathies of the upper extremities, and a frequent cause of hand pain and impaired function. CTS results from compression or injury of the median nerve at the wrist within the confines of the carpal tunnel. Patients with CTS usually experience pain, numbness, tingling, and a sensation of swelling over the median nerve distribution area of the hand. A classic reported symptom is awakening at night due to numbness and pain in their hand, occasionally extending to the shoulders, but is relieved by shaking the wrist [9]. As most of the study was based on the population in Western countries and the life style and the ethnicity between Chinese people and Western country people is quite different, there may be some similarities and differences in epidemiology. The prevalence of CTS in the general population has been estimated to be between 7% and 19% given the caveats about the case definition, and its etiology is multifactorial and includes systemic disorders, such as diabetes mellitus, hypothyroidism, and obesity; post-menopausal females are also commonly affected [10]. Systemic, anatomical, idiopathic, and ergonomic factors could be significant in the etiology since some parameters such as age, sex, and body mass index (BMI) could be risk factors for CTS. A BMI value over 30 is classified as obesity; although some studies show a relationship between BMI and CTS, its relationship with anthropometric measurements, such as waist circumference and wrist circumference, is not clear [11]. This aim of study to observe on individual risk factors of carpal tunnel syndrome In Bangladeshi Population.

MATERIALS AND METHODS

The present case-control study was conducted at the Dept of Neurology, Uttara Adhunik Medical College Hospital (UAMCH), Uttara, Dhaka, Bangladesh from January 2019 to December 2021. Included 3019 patients in our study and who were diagnosed in the 84% of patients were aged 41-70 years both case and control groups. Both groups filled out a standardized questionnaire, and a standardized patient record was filled out by Neurology Department. In addition, participants with jobs involving lifting and carrying of loads were interviewed. The incidence of CTS in middle aged women was significantly higher than that in men. The patients' history and the physicians' findings were recorded including information on general health status, general use of

wrist and hands. All the persons who were suspected of CTS received the neural electrophysiological examination to diagnose the disease. Recruitment and inclusion criteria of cases and controls. The inclusion criteria were as follows: age 41-70 years. People in the case group with the symptom 'numbness' were clinically and neural-electro physiologically diagnosed as CTS. People in the control group were excluded the symptom 'numbness'. The case group included clinically diagnosed CTS which was divided into 4 parts at every 10 years of age. The sex of the patients of the control group was matched to the case group and divided into 4 parts by age.

Statistical Analysis

The study evaluated the risk factors of CTS to obtain the odds ratio (OR) and the P-value of these factors. Then all the data were imported to the database by Epidata Ver. 3.1 and processed by SPSS Ver. 20.0 for regression analysis.

RESULTS

In our study 3019 patients who were diagnosed in the 84% of patients were aged 41-70 years. Among these patients, there were 756 CTS patients aged 41-70 years without any other diseases which could cause numbness as the case group. Then there were 2263 non-CTS outpatients involved as the control group. The average BMI in case group was 22.79 ± 2.60 and 21.49 ± 5.03 in control group with significant difference ($P < 0.01$) (Table-1). Predictors of CTS. The risk ratio of 51-60 age group is OR 1.334 (95% CI, 1.178-1.059) based on 41-50 as age group, while there was no statistical significance in 61-70 age group, which shows that 51-60 years of age in this study is the highest risk age (Table-2). There were 96 patients (12.70%) who were educated in the primary school in case group and 16 patients (0.71%) in the control group. The number of patients who were educated up to secondary school was 336 (44.44%) in the case group and 680 (29.98%) in the control group. The number of high school patients was 152 (20.11%) in the case group and 788 (34.74%) in the control group. The number of College/Graduation Degree patients was 172 (22.75%) and 784 (34.57%). There were 100 as mild patients (13.22%), 601 moderate patients (79.89%) and 52 severe patients (6.88%). There were 100 as mild patients (13.28%), 601 moderate patients (79.81%) and 52 severe patients (6.90%) (Fig-1).

Table-1: General information of the persons involved in the study.

Sex	Age (years)	Case group	Control group
Male	41-50	56	136
	51-60	32	70
	61-70	44	186
Female	41-50	272	524
	51-60	168	438
	61-70	184	909

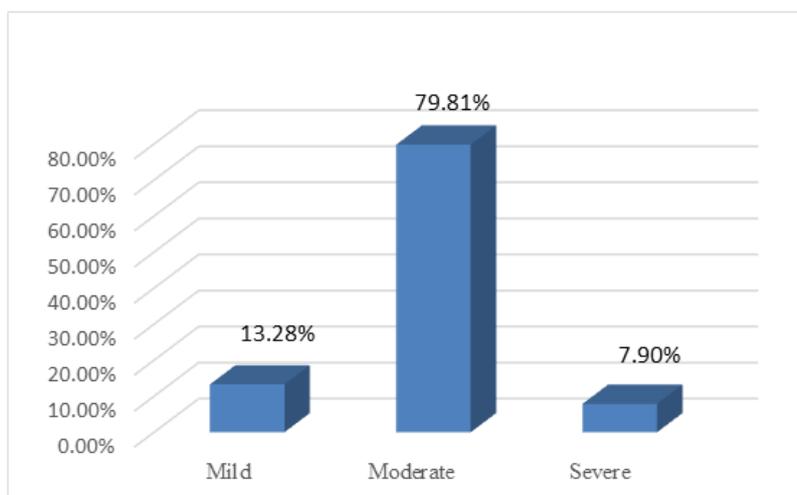
Table-2: The relationship between age and CTS.

Item	P-value	OR	95% CI
Age (year)	0.001	0.99	0.984-0.996
41-50 years	0.043	0.981	0.963-0.999
51-60 years	<0.001	1.412	1.337-1.490
61-70 years	<0.001	1.239	1.187-1.292

CTS, carpal tunnel syndrome; OR, odds ratio; CI, confidence interval.

Table-3: The relationship between education perception and CTS.

Education level	Case Group	Control Group
primary school	96 (12.70%)	16(0.71%)
secondary school	336 (44.44%)	680 (29.98%)
high school/C	152 (20.11%)	788 (34.74%)
College/Gradation Degree patients	172 (22.75%)	784 (34.57%)

**Fig-1: Several patients level of CTS.****Table-4: The relationship between education level and CTS.**

Education level	P-value	OR	95% CI
Primary school	<0.001	25.328	17.16-37.392
Secondary school	<0.001	2.227	1.918-2.585
High school	0.139	0.88	0.743-1.042
College/Gradation Degree		1	

CTS, carpal tunnel syndrome; OR, odds ratio; CI, confidence interval.

This showed that patients in control group were more educated. The OR of patients in primary school education is 25.328 (95% CI, 17.16-37.392) ($P<0.01$). The OR of patients in secondary school

education is 2.227 (95% CI, 1.918-2.585) ($P<0.01$). The OR of patients in high school education is 0.880 (95% CI, 0.743- 1.042) ($P>0.05$) (Table-4).

Table-5: Exposed parameters in case group.

Exposed parameters	Case group			
	Exposed	%	Unexposed	%
Alcohol	216	28.57	540	71.43
Cigarette	160	21.16	596	78.84
Injury	57	7.54	699	92.46
Diabetes	132	17.53	623	82.47
Hypertension	152	20.17	603	79.83
Hypothyroidism	64	8.47	692	91.53

Table-6: Exposed parameters in control group.

Exposed parameters	Control group			
	Exposed	%	Unexposed	%
Alcohol	724	15.96	3812	84.04
Cigarette	268	5.91	4268	94.09
Injury	336	7.41	4200	92.59
Diabetes	560	12.35	3976	87.65
Hypertension	1126	24.82	3410	75.18
Hypothyroidism	264	5.82	4272	94.18

Table-7: The relationship between wrist injury and CTS.

Item	P-value	OR	95% CI
Wrist injury	0.035	1.313	1.019-1.691
41-50 years	<0.001	2.525	1.625-3.337
51-60 years	0.995	<0.001	<0.001
61-70 years	1	<0.001	<0.001

CTS, carpal tunnel syndrome; OR, odds ratio; CI, confidence interval.

Table-8: The relationship between related diseases and CTS.

	OR	95% CI
Age	0.99	0.984-0.996
BMI	1.096	1.077-1.115
smoking	4.862	3.991-5.925
wrist injury	1.313	1.019-1.691
diabetes mellitus	1.837	1.557-2.168
hypertension	0.805	0.688-0.942
hypothyroidism	1.385	1.119-1.715

CTS, carpal tunnel syndrome; OR, odds ratio; CI, confidence interval.

The investigated factors in the case group and control group as listed (Table 5 & 6). The OR of age is 0.990 (95% CI 0.984-0.996). The OR of BMI is 1.096 (95% CI, 1.077-1.115). The OR of smoking was 4.862 (95% CI, 3.991-5.925). The OR of wrist injury was 1.313 (95% CI, 1.019-1.691). The OR of diabetes mellitus is 1.837 (95% CI, 1.557-2.168). The OR of hypertension is 0.805 (95% CI, 0.688-0.942). The OR of hypothyroidism is 1.385 (95% CI, 1.119-1.715). The OR of these factors in each age group is listed (Table 7 & 8).

DISCUSSION

The causal relationship between the CTS development and computer-related tasks has been disputed for several decades [12]. The use of mouse and keyboards requires a repetitive hand activity and non-neutral wrist postures, and both conditions have been identified as risk factors for CTS, but no decisive evidence has been still established [13]. In the last 30 years, CTS epidemiology in VDU workers has been repetitively described and even very large cohorts have been reported [14]. Unfortunately, several studies incorporated in the more recent and evidence based reviews have been largely criticised [12]. This result is similar to the age distribution of the patients mentioned above. In this study, the study subjects were selected in the age range of 41-70 years. At this age, the increase of the age and the incidence of CTS does not have a strong

positive correlation. Patients in 51-60 years of age should pay more attention to the incidence of CTS during the diagnosis and treatment. The low education level proportion in case group is significantly higher than in the control group, the primary school education level (OR=25.328; 95% CI, 17.16-37.392) and the junior school education (OR=2.227; 95% CI, 1.918-2.585) showed a strong positive correlation with the occurrence of CTS. There have been no studies in Western countries, which may be related to the higher average education level in the developed countries and the lesser extreme low education level. Atroschi *et al.*, [15] found CTS incidence rate from age 45-65 years increased significantly both in male and female patients in a sample survey in Sweden, and the incidence of reported clinical and electro-physiological dual diagnosis of CTS was at the rate of 2.7% (95% CI, 2.1-3.4%). There are similar results in the study by Nathan *et al.*, [16] and Lam and Thurston *et al.*, [17]. The higher education level of the population in the case group was lower but the difference between the two did not have statistical significance. In this study, OR of BMI was 1.096, 95% CI (1.077-1.115), which had statistical significance ($P < 0.01$). $0.9 < OR < 1.1$ indicated that BMI did not have a clear increase in the risk of CTS, but $OR > 1$ showed that it had a trend to increase the risk of CTS. This difference may be related to the incidence of obesity worldwide, however, the study results of OR difference is not large, which may be related to the differences in the study sample and

random population. Luchetti *et al.*, [18] proposed the CTS classification of patients with CTS severity of mild, moderate and severe. Therefore, the impact of education on the incidence of CTS is more reflected in the low educational level. On the other hand, the low education level for the acceptance and understanding defects in the progress of health education, further weakened the ability of self-protection of their wrist in the process of work, which increased the risk of CTS occurrence. The different severity of CTS in patients with the factors of education degree was not significantly different, so that the level of education is not the indicative factor for the severity of carpal tunnel. According to this classification, the BMI index had a weak correlation between the occurrences of the syndrome in patients with moderate carpal tunnel, that is to say that the risk of obesity in patients with moderate CTS was higher, but for the mild and severe CTS, the results were not statistically significant. Previous studies had indicated that smoking could affect the local microcirculation [19], which could lead to local hypoxia, injury of vascular endothelium and micro-thrombus. According to the microcirculation ischemia theory of CTS, smoking could affect the occurrence of CTS, which was mentioned in the study in Nathan *et al.*, [20], while different opinion exist [21]. In this study, 160 cases were smokers of whom 134 were in the control group. The proportion of smokers in the case group was higher. Alcohol could cause nerve axonal degeneration and demyelination, often involving a fine feeling of optic nerve fibers, with axon alde generation characterized. These symptoms appeared in long-term alcohol abuse patients. In this study, there was no clear evidence that alcohol caused the increasing risk of CTS. However, long-term and excessive drinking would lead to peripheral neuropathy, numbness and other symptoms. There are not many studies on the effects of alcohol on CTS [22]. Some reported that CTS patients were less among mild and moderate drinkers but no further studies exists. We presumed that there was no significant correlation with the amount of alcohol consumption and CTS, but long-term excessive drinking could increase the risk of CTS. In this study, drinking OR was 1.023 (95% CI, 0.881-1.306) with no statistical significance which is consistent with the above studies. The carpal tunnel is an osteofibral pipeline which connects the forearm and the palm. As the carpal tunnel volume ductility, any parts of the carpal tunnel damage may lead to a decline in the volume of the carpal tunnel, which can lead to the median nerve compression and the symptoms of CTS. These injuries include carpal fractures, through which the peripheral nerve and tendon is damaged and the surface of the transverse carpal ligament injury. Hyper plastic fibrous connective tissues may fill the carpal tunnel or limit the expansion of the carpal tunnel because of the proliferation of fibrous connective tissue during the healing process when the wrist injury occurred, which resulted in the compression of the median nerve, however it was combined with the

severity of patients with CTS analysis, no regular characteristics were found. Therefore, the wrist trauma was only a risk factor for the incidence of CTS, but could not be the indicator of the severity on CTS. Diabetes can cause local median nerve microcirculatory disorders, followed by chronic peripheral nerve injury. Ferry *et al.*, [23], reported a similar study. In our study the investigated factors in the case group and control group as listed. The OR of age is 0.990 (95% CI 0.984-0.996). The OR of BMI is 1.096 (95% CI, 1.077-1.115). The OR of smoking is 4.862(95% CI, 3.991-5.925). The OR of wrist injury is 1.313 (95% CI, 1.019-1.691).The OR of diabetes mellitus is 1.837 (95% CI, 1.557-2.168). The OR of hypertension is 0.805(95%CI, 0.688-0.942). The OR of hypothyroidism is 1.385 (95% CI, 1.119-1.715). The OR of these factors in each age group is listed. Non-diabetic patients in moderate and severe patients accounted for a lower proportion, indicating that patients with diabetes had higher risk of moderate or higher CTS. Hypertension is a clinical syndrome characterized by elevated systemic arterial pressure, which can lead to damage of target organs, and is associated with systemic metabolic changes. In this study, the OR of hypertension was 0.805 (95% CI, 0.688-0.942). Although the incidence of CTS was weakly related, it had statistical significance. Other similar studies were not found. It showed that the occurrence of CTS was a protective factor in this study. Thus, the role of these factors in the performance of different ages varied, so that personalized treatment should be carried out based on the age level of the patients. Hypothyroidism is a group of endocrine diseases caused by thyroid hormone synthesis, secretion or biological effect. Ferry *et al.*, [23], reported that hypothyroidism could increase the risk of CTS. It was supposed that the release of thyroid hormone could reduce the formation of foam-like changes. The deposition of false mucin on the surface of the median nerve can lead to median nerve injury [24, 25]. Effect of rheumatoid arthritis on the tissue in the wrist is obvious. In this study, rheumatism OR was 4.450 (95% CI, 3.712-5.215), showing that the risk of rheumatic diseases will significantly increase the CTS, but further analysis found there was no directivity in the severity by age stratification. Since the rheumatoid arthritis usually occurs in the wrist, RA synovial hyperplasia is obvious in the wrist. The synovial invasion of the normal space in the carpal tunnel results in the stenosis of the carpal tunnel, and then causes the entrapment of the median nerve. Combined with the median nerve of peripheral vascular invasion of rheumatoid vasculitis caused by local blood supply affected and further aggravated the injury of the median nerve.

CONCLUSION

In conclusion, sex, age, smoking, wrist injury, diabetes mellitus, hypothyroidism and wrist working are all risk factors of CTS. Hypertension could be a protection factor of CTS in early phase but will raise the

risk in a long-term high blood pressure. Smoking, alcohol and diabetes mellitus can be the predictors of moderate and severe CTS. Elder people are effected by the working factors compared to younger people.

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