Prevalence of Probable Carpal Tunnel Syndrome and its Associated Factors among Dentists in Kelantan

Munirah MA¹, Normastura AR^{1*}, Azizah Y¹, Aziah D²

 ¹ School of Dental Sciences, Health Campus, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia
 ² School of Medical Sciences, Health Campus, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia

* *Corresponding Author:* Assoc. Prof. Dr. Normastura Binti Abd Rahman School of Dental Sciences, Health Campus, Universiti Sains Malaysia, Kelantan, Malaysia Email: normastura@usm.my

Abstract

Introduction: Carpal Tunnel Syndrome (CTS) is one of the common musculoskeletal problems among dental personnel.

Aim & Objectives: The aims of this study were to determine the prevalence of probable CTS and its association with individuals, work characteristics and psychosocial factors among government dentists in Kelantan, Malaysia.

Methods: The design of the study was a cross-sectional study. The study was conducted on 109 government dentists in Kelantan. A self-administered questionnaire consisted of sociodemographic, individuals, work characteristics, psychosocial factors and clinical diagnosis questionnaire was used. Data were entered and analyzed using SPSS version 20.0. Study respondents were categorized into 'probable CTS' and 'non-probable CTS' based on scoring of the clinical diagnosis questionnaire. The association between associated factors (individual factors, work characteristics and psychosocial job factors) and probable CTS was calculated using multiple logistic regression analysis.

Results: Ninety-nine dentists completed and returned the questionnaire (response rate= 90.8%). Majority of the study respondents were female (81.8%) and Malay (93.9%). Their mean age was 32.5 years old (SD=7.32). The prevalence of probable CTS was 21.2% (95% CI: 13.0-29.4). After controlling all possible confounders by using multiple logistic regression, it was found that chronic disease and decision latitude were significantly associated with probable CTS. Suffering from a chronic disease increases the odds of having probable CTS by 26.5 (95% CI: 2.1, 334.8) times. It was also found that for every 1 unit increased in the decision latitude, the risk of having probable CTS was 0.8 (95% CI; 0.7, 0.1) times lower.

Conclusion: The prevalence of probable CTS among dentists in this study population was relatively high. Having chronic disease and low in decision latitude were significantly associated with the risk of developing probable CTS.

Key words: Dentist, carpal tunnel syndrome, individual factors, work characteristics, psychosocial job factors, Kelantan, Malaysia

Introduction

Carpal tunnel syndrome (CTS) arises from compression of the median nerve where it passes through the carpal tunnel in the wrist. The classical presentations are burning sensations, pins and needles and/or numbness in the distribution of the median nerve. This typically occurs initially at night, and then early in the morning. Other symptoms include weakness of thumb grip, a history of dropping things, and clumsiness of fine finger function.¹ CTS is one of the common musculoskeletal problems among dental personnel². Prolonged work with highly repetitious flexion and extension of the wrist, and forceful grip task was shown to increase the risk to develop CTS.³

This problem may be precipitated by exposure to several factors such as individual, work characteristics and psychosocial work factors. Those older in age^{4,5}, female, with increased body mass index (BMI)^{5,6}, chronic diseases⁵, history of using contraceptive pills or hormone replacement therapy (HRT)⁶, and history of trauma⁶ were shown to have higher risk for CTS. Hamann *et al.* (2001) identified that dentists diagnosed with CTS are those who practiced longer in the dental clinical profession.⁷ This was supported by Lalumandier and McPhee (2001) who found that dental hygienists who practiced for more than 10 years were more likely to develop CTS⁸. High job demands and low social support as part of the psychosocial job factor were identified as risk factors of hand and wrist symptoms.⁹ A study by Lalumandier and McPhee (2001) found that dental hygienists who were dissatisfied with their job were more likely to have hand problems than those who were satisfied with their job⁸. High prevalence of oral health diseases such as caries^{10,11} and periodontal diseases¹² in Kelantan contributed to the increase in work burden to the dentists in order to fulfill the need and demand of dental services. This situation may lead to higher prevalence of CTS among dentists in Kelantan.

Therefore, in the present study, we aimed towards a better understanding on the magnitude and factors associated with this problem among dentists in our study population. Evidence from this study could be useful to be a baseline data to establish further study and conduct intervention programs for prevention of CTS especially in Malaysia.

Methods

Study design and respondents

A cross-sectional study was conducted from May 2013 until October 2013 among government dentists in Kelantan, Malaysia. The reference population of this study was all government dentists in Kelantan and the source population was government dentist in Kelantan who fulfilled the inclusion and exclusion criteria. The inclusion criteria were dentists who work in government

dental clinics in Kelantan and those who were pregnant, and have work experience less than 12 months were excluded from the study.

The sample size was calculated using the single proportion formula based on the prevalence of CTS among US army dentists at 28%.⁸ In calculation, the precision was set at 0.09 at the power of 80% with the anticipation of 20% non-response, a total of 115 dentists were needed in this study.

A list of dentists who work in government dental clinic in Kelantan was obtained. The total number of dentists in Kelantan who fulfilled the study criteria was 109. Therefore, all of them were recruited.

Research Tools

A self-administered questionnaire consisted of socio-demographic data, individual factors, work characteristics, psychosocial job factors and clinical diagnosis questionnaire was used. Socio-demographic data consisted of questions related to age, sex, race, marital status, education level and monthly household income of the respondents. Individual factors assessed factors related to body mass index (BMI), history of taking hormone replacement drugs, chronic diseases (diabetes mellitus, osteoarthritis or rheumatoid arthritis) and exercise. The work characteristics questions were adopted from Samat *et al.* (2011).¹³ Through these questions, respondents were asked about total work duration, duration of use of dental instruments, work rest pattern, duration of use of computer in a day during office hour and after office hour.

A validated Malay version of the Job Content Questionnaire (JCQ) was used to measure the psychosocial status of the workers related to work tasks. The Malay version was derived from the 49 items of JCQ 1.5 (Revised 1996), including added scales and extension of original scales for the Framingham version.^{14,15} Twenty-one items selected constituted a minimum set of questions for three major scales of the JCQ which are decision latitude (8 items), psychological job demand (7 items) and social support (6 items).¹⁶ Most items were scored on a Likert scale of 1 to 4 (strongly disagree, disagree, agree and strongly agree; or often, sometimes, rarely and never). All scales (decision latitude, psychological job demand and social support) were calculated using the formulae for Job Content instrument scale construction provided in the Job Content Questionnaire and User Guide.¹⁵

This present study used a clinical questionnaire by Kamath and Stortard (2003) to define CTS.¹⁷ This questionnaire was developed by Kamath and Stothard (2003) based on work done by Levine *et al.* (1993).¹⁸ According to Kamath and Stortard (2003), the diagnostic questionnaire is very useful as a preliminary screening tool for CTS, for diagnosis, and as a supplement to diagnose CTS in primary care. In measuring sensitivity of the questionnaire, they used clinical response to surgical decompression as the marker for CTS. Patients who reported a good response to surgery after two weeks of the operation were assumed to have CTS. This instrument has been reported to achieve sensitivity of 85%, as compared to 92% with the nerve conduction test. This questionnaire has been translated into Malay language and was pretested among clerical staff in Pasir Puteh, Kelantan.¹⁹ It consists of nine hand symptoms commonly related to

CTS, including pain, tingling and numbness cause wake up at night, tingling/numbness in the morning, trick movements, tingling of little finger, tingling during resting, neck pain, severe pain during pregnancy, and relief with a splint.

This study categorized those who scored 3 and above used by Kamath and Stothard¹⁷ as probable CTS. It was adopted from case definition of probable CTS in a study by Lalumandier and McPhee.⁸ According to the study, three or more symptoms related to CTS classified an individual as probably having CTS.⁸ Symptoms which were investigated in their study were pain at night, tingling, decreased sensation, frequent dropping of objects, sensation of 'falling asleep' during normal activity, stiffness, loss of strength and morning swelling.⁸

Data collection process

Prior to data collection, a request letter, information sheet and copies of consent form were sent to respective dental clinics in Kelantan to obtain approval and provide better understanding of the research project. All dentists who fulfilled the study criteria were invited to participate in the study. A self-administered questionnaire was distributed to the dental personnel with the help of the person in charge of the dental clinics.

Statistical Analysis

SPSS version 20 statistical software was used for data entry and analysis. Presence of probable CTS was coded as "1" and without probable CTS was coded as "0". Data were checked, explored and cleaned. Data exploration was done using descriptive statistics. Evaluation of normality and outliers from the dependent variables were conducted. Mean and standard deviation (SD), or median and interquartile range (IQR) were calculated for each continuous variables and for categorical variables, frequency and percentages (%) were determined.

Univariable and multivariable analysis were conducted to determine the associated factors of probable CTS. Variables that were significant at p<0.25 and had clinical significance were included in the analysis.²⁰ The preliminary main effect model was checked for all possible two-way interactions and multicollinearity before obtaining the final model. The multicollinearity was checked using correlation matrix. Fitness of the final model was assessed by Hosmer-Lemershow goodness of fit test. If the p-value approached one, the model was perfect fit. The Receiver Operating Characteristics (ROC) curve was plotted and the area under the curve and classification for sensitivity and correctly classified were obtained in order to evaluate the model fitness.

Ethical approval and funding

This study was approved by the Human Research and Ethics Committee, Universiti Sains Malaysia (USM) on 21st February 2013 (Ref: USMKK/PPP/JEPem (260.4.[5.16]). The study

was also registered at the National Medical Research Register of Malaysia (NMRR) (NMRR ID: NMRR-12-1235-13407) and was funded by USM incentive grant.

Results

A total of 109 dentists fulfilled the inclusion criteria, however 99 of them participated in this study (response rate= 90.8%). Table 1 shows the socio-demographic characteristics of the respondents. Majority (81.8%) of the dentists was female and 93.9% of them were Malays. Their mean age was 32.5 years (SD= 7.32).

The prevalence of CTS among dentists was measured based on the score of three and above of Kamath and Stothard (2003) questionnaire. The prevalence of probable CTS among dentists in Kelantan was 21.2% (95% CI: 13.0, 29.4).

Table 2, 3 and 4 show the summary results of univariable analysis of the association between individual, work characteristics, and psychosocial job factors and probable CTS respectively. None of the individual factors variables and work characteristics in the univariable analysis was significantly associated with probable CTS. For the psychosocial job factors, dentists with probable CTS had significantly lower decision latitude [mean (SD) = 59.0 (4.03)] compared to non-probable CTS [mean (SD) = 62.3 (4.73)].

Table 5 shows the summary results of multiple logistic regression analysis of the association between factors associated (individual factors, work characteristics and psychosocial job factors) and probable CTS among dentists. After controlling all possible confounders which were clinically related (age, sex and BMI) and variables with p-value less than 0.25 of the univariate analysis through multiple logistic regression, it was found that chronic disease and decision latitude were significantly associated with probable CTS. As for chronic disease status, suffering from a chronic disease increases the odds of having probable CTS by 26.5 (95% CI: 2.1, 334.8). It was also found that for every 1 unit increase in the decision latitude of the dentists, the risk of having probable CTS was 0.82 (95% CI; 0.71, 0.95) times lower.

Discussion

Majority of the dentists in this study were female (81.8%) and most of the dentists were Malay (93.9%). It reflected the composition of Kelantan population which was predominated by Malay as compared to other races.²¹

The prevalence of probable CTS was higher than previous studies by Hamann *et al.* (2001) and Haghighat *et al.* (2012).^{7,22} Hamann *et al.* (2001) showed that the prevalence of dentists with CTS was 2.9% as defined by 0.8-ms prolongation of electro diagnostic criterion and had symptoms consistent with CTS.⁷ Haghighat *et al.* (2012) reported lower prevalence of probable CTS among dentists in Isfahan, Iran $(16.7\%)^{22}$ where the diagnosis of CTS was based on numbress or pain in territory of median nerve and positive Phalen and Tinel clinical tests. In

contrast, Alexopoulos *et al.* (2004) found that 26.0% of dentists in Thessaloniki, Greece had complaints of pain in hand and wrist which was higher than the prevalence of CTS in our study.²³ They used standardized Nordic Questionnaire to measure musculoskeletal complaints among dentists. Lalumandier and McPhee (2001) conducted a study among United States Army dentists and the prevalence of CTS among dentists in their population was 28%.⁸ High prevalence of hand and wrist pain was also found in Australian dentist (34%) as reported by Leggat *et al.* (2007).²⁴ Puriene *et al.* (2010) reported much higher prevalence of hand pain and CTS expected complaints (83.1%) among Lithuanian dentists². However, these comparisons need to be cautiously done because of the different definition of CTS between the various studies. For example, Hamann *et al.* (2001) defined CTS based on the prolongation of electrodiagnostic criterion (0.8-ms) and symptoms consistent with CTS, while Haghighat *et al.* (2012) diagnosed CTS based on the numbness or pain in territory of median nerve and positive Phalen and Tinel clinical tests.

Even though the prevalence of caries and periodontal disease in Kelantan were high, as reported in the National Oral Health Survey^{10,12,25} and led to work burden, interestingly it was not associated with the high prevalence of probable CTS among dentists in Kelantan as compared to other countries which reported lower prevalence of oral diseases.^{8,23} Lower prevalence of probable CTS among dentists in Kelantan as compared to dentists in other countries might be related to the oral health system in Malaysia. Malaysia, which follows the New Zealand dental nurse model, has dental nurses as operating allied health personnel. Under the supervision of dentists, dental nurses deliver oral health service to school children aged 17 years old and below.²⁶ The roles of dental nurses in dental services complement the work of dentists in Malaysia. According to Chang et al. (2009)²⁷, dentists and dental nurses well being was presumably related to the smooth and possible collaboration for efficient job performance. However, surprisingly some recent studies suggested that close relationship in fact may lead to the transfer of burnout from one professional to the other.²⁸ Various types of tasks performed by dentists range from administrative, preventive, curative and palliative works may contribute to lower prevalence of probable CTS. The various nature of work done by dentists may influence the reduction of repetitiveness during clinical work, since repetitive work is associated with the risk of CTS.29

During five years dental training before they become a qualified dentists, they were taught about ergonomic and hazards in dental clinics including risk of CTS. The higher education level promotes better awareness about dental ergonomics.³⁰ Therefore, it is hypothesized that the occurrence of CTS would be prevented. However, a study conducted by Thornton *et al.* (2008) found that third year dental students were reported with high prevalence of musculoskeletal symptoms of neck, shoulder and back.³¹ Therefore, it was suggested that thorough preventive and ergonomic strategies need to be carried out before the dental students start their clinical dental work at the dental school.

Finding of this study showed that dentists with chronic diseases were 26.5 times of experiencing probable CTS compared to those with no chronic diseases (OR: 26.5; 95% CI: 3.2,16.8). Diabetes mellitus may be associated with several pathologic conditions related to the hand, including CTS.^{5,6} Diabetic neuropathy is one of the reasons in the development of CTS among people with diabetes.³² The median nerve is sensitive to any entrapment within the canal tunnel.

Pathogenesis of CTS could be explained by proliferation of connective tissue and microvascular insufficiency which later lead to nerve entrapment and presence of signs and symptoms of CTS. Trapeziometacarpal joint osteoarthritis is common after the age of 50, especially among women. CTS is often associated with degenerative articular pathologies such as arthritis of the trapeziometacarpal joint³³. Rheumatoid arthritis is one of the causes that constantly produce a tenovaginitis and consequently CTS. Tenovaginitis is a thickening of the flexor tendon sheath. The pathologic proliferation of the sheath causes oedema and water retention leads to a secondary CTS.¹ The other significant associated factor of probable CTS among dentists was decision latitude. Decision latitude had negative association with probable CTS. Low decision latitude may increase the risk of probable CTS (OR: 0.8; 95% CI: 0.7, 1.0). Karasek (1979) in the Job Strain Model defined decision latitude as the working individual's potential control over his tasks and his conduct during the working day. Decision latitude is a combination of two distinct sub-dimension which were highly correlated; skill discretion and decision authority.³⁴ Skill discretion was defined as the level of skill and creativity required on the job and the flexibility which permitted the worker to decide what skills to employ as well as to learn new things and decision authority was defined as the organizationally mediated possibilities for workers to make decisions about their work.¹⁴ Decision authority is measured by freedom in decision making, choosing how to do a task, and having a say on the job.

Low in decision latitude can be expressed as low in skill discretion and low decision authority. As reported by Canivet *et al.* (2013), they predicted that low decision latitude, high psychological demands and job strain would be associated with disability among pensioners in Sweden. Decision latitude is related to the ability of the dentists to control over the performance of their own work. Dentists who are at higher grade of work position may have better work control and reduce the risk of CTS. Promotion of better job control at work place will increase the job satisfaction of the dentists and reduce the risk of probable CTS among dentists.³⁵

The findings of this study were the result of a cross-sectional study. Causal inferences cannot be drawn from this type of study design. Therefore a cohort study needs to be done to measure causal relationship. This study also used self-administered questionnaire which may contribute to recall bias. Diagnosis of probable CTS in this study was based on the questionnaire which relied on self reporting. Perhaps more accurate results would be obtained by performing nerve conduction tests, but this method is time consuming and requires a great deal of cooperation from study respondents.

Conclusions

There was a relatively high prevalence of probable CTS among dentists in Kelantan. Having chronic disease and low decision latitude were associated with probable CTS. Improving the awareness related to the risk of CTS may potentially reduce the risk of CTS among dentists leading to a better quality of dental service.

Competing interests: The authors have no known conflicts of interest related to the work in this study and there has been no significant financial support for this work that could have influenced its outcome.

Authors' contributions:

1. Munirah Mohd Adnan. Doctorate in Dental Public Health, USM

Contribution: analysis, interpretation of data and drafting the article

- 2. Normastura Abd. Rahman. M. Community Medicine (Oral Health), USM
- Contribution: Conception and design, analysis, interpretation of data and drafting the article 3. Azizah Yusoff. DDPHRCS (England)

Contribution: Conception and design, interpretation of data and drafting the article

4. Aziah Daud. M. Community Medicine (Occupational Health), USM

Contribution: Conception and design, analysis, interpretation of data and drafting the article

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Variables	Freq (%)
Age	32.5 (7.32) ^a
Sex	
Male	18 (18.2)
Female	81 (81.8)
Race	× ,
Malay	93 (93.9)
Chinese	5 (5.1)
Indian	1 (1.0)
Marital Status	
Single	21 (21.2)
Married	77 (77.8)
Widowed/ divorced	1 (1.0)
Education Level	
Degree	92 (92.9)
Master	7 (7.1)
Household Income (Monthly)	8346.1 (4328.81) ^a

 Table 1: Socio demographic characteristics of dentists in Kelantan (n=99)

^a Mean (SD)

 Table 2: Univariate analysis for association between individual factors and probable CTS among dentists (n=99)

Variables	Probable CTS n=21	Non Probable CTS n=78	Crude OR (95% CI)	X ² stat (df)	<i>p</i> -value
	n (%)	n (%)			
Sex					
Male	4 (22.2)	14 (77.8)	1		
Female	17 (21.0)	64 (79.0)	0.93		1.000^{f}
			(0.27, 3.19)		
Age	31.9 (6.39) ^d	32.3 (7.59) ^d	-0.48	-0.26	0.79 ^b
			(-4.07, 3.11)	(97)	
Household Income	8692.1	8253.0	439.14	0.41	0.682 ^b
(monthly)	$(2762.26)^d$	$(4671.82)^{d}$	(-1682.05,	(97)	
			2560.33)		
BMI	24.9 (4.67) ^d	23.8 (3.78) ^d	1.08	1.10	0.274 ^b
			(-0.87, 3.02)	(108)	
Hormone Replacement Drug*					
No	15 (19.5)	62 (80.5)	1		

Yes	2 (50.0)	2 (50.0)	4.13		0.192 ^f
	()		(0.54, 31.77)		
.t.					
e*					
No	17 (18.7)	74 (81.3)	1		
Yes	4 (50.0)	4 (50.0)	4.35		0.06^{f}
			(1.00, 19.18)		
x 7	5 (12 5)	22(0(5))	1		
Yes	5 (13.5)	32 (86.5)	1		
No	16 (25.8)	46 (74.2)	2.23	2.20(1)	0.122 ^a
			(0.74, 6.69)		
	Yes e* Yes No	Yes 2 (50.0) e*	Yes2 (50.0)2 (50.0) e^* No 17 (18.7)74 (81.3)Yes4 (50.0)4 (50.0)Yes5 (13.5)32 (86.5)No16 (25.8)46 (74.2)	Yes2 (50.0)2 (50.0) 4.13 (0.54, 31.77)e*(0.54, 31.77)No17 (18.7)74 (81.3)1Yes4 (50.0)4 (50.0)4.35 (1.00, 19.18)Yes5 (13.5)32 (86.5)1No16 (25.8)46 (74.2)2.23 	Yes 2 (50.0) 2 (50.0) 4.13 (0.54, 31.77) e* (0.54, 31.77) No 17 (18.7) 74 (81.3) 1 Yes 4 (50.0) 4 (50.0) 4.35 (1.00, 19.18) Yes 5 (13.5) 32 (86.5) 1 No 16 (25.8) 46 (74.2) 2.23 2.20 (1) (0.74, 6.69)

^a Likelihood Ratio Stat, ^b Independent t-test, ^cMan Whitney test, ^d Mean (SD), ^e Median (IQR), ^f Fisher exact test, *Includes only female dental officers, n=81, **Dental officers who performed clinical works, n=95.

* Chronic disease referring to medical history of the respondents either they are having diabetes mellitus, osteoarthritis or rheumathoid arthritis.

Variables	Probable CTS	Non Probable CTS	Crude OR	X ² stat	<i>p</i> -value
	n=21	n=78	(95% CI)	(df)	
	n (%)	n (%)			
Duration of employment (month)	59.0 (37.00) ^e	52.0 (67.00) ^e		-0.57	0.572°
Duration use of dental instruments (month)	59.0 (37.00) ^e	52.0 (67.00) ^e		-0.57	0.566°
Use of dental instruments per day (hours)**	6.0 (0.97) ^d	5.6 (1.86) ^d	0.4 (-0.45, 1.23)	1.30 (62.97)	0.199 ^b
Take break during use of instruments**					
\leq 50 minutes	4 (15.4)	22 (84.6)	1		
> 50 minutes	17 (24.6)	52 (75.4)	1.80 (0.54, 5.96)	0.99 (1)	0.319ª
Use of Computer At Clinic Per Day (minutes)	60.0 (65.0) ^e	42.5 (95.00) ^e		-0.05	0.959°
At home Per Day (minutes)	60.0 (120.00) ^e	60.0 (111.50) ^e		-0.70	0.485°

Table 3: Univariate analysis for association between work characteristic factors and probable CTS among dentists (n=99)

^a Likelihood Ratio Stat, ^b Independent t-test, ^c Man Whitney test, ^d Mean (SD), ^e Median (IQR), *Includes only female dental officers, n=81, **Dental officers who performed clinical works, n=95

Variables	Probable CTS	Non Probable CTS	Mean difference	t stat	<i>p</i> -value
	n=21	n=78	(95% CI)	(df)	
	n (%)	n (%)			
Decision Latitude	59.0 (4.03) ^d	62.3 (4.73) ^d	-3.3	-2.89	0.005 ^b
			(-5.50, -1.02)	(97)	
Psychological Job	15.1 (2.21) ^d	15.9 (2.65) ^d	-0.8	-1.23	0.222 ^b
Demand			(-2.03, 0.48)	(97)	
Social Support	19.7 (4.81) ^d	20.5 (4.56) ^d	-0.8	-0.70	0.485 ^b
			(-3.04, 1.45)	(97)	

 Table 4: Univariate analysis for association between psychosocial associated factors and probable CTS among dentists (n=99)

^b Independent t-test, ^d Mean (SD)

 Table 5: Association between individual, work characteristic and psychosocial associated factors and probable CTS among dentists by using Multiple Logistic Regression* (n=99)

Variables	b	Adj OR (95% CI)	Wald stat (df)	<i>p</i> -value
Chronic Disease	Ţ	1		
Ŋ	No Zes 3.28	1 26 48 (2 09 334 80)	21 25 (1)	0.011
-		20.10 (2.0), 55 1.00)	21.20 (1)	0.011
Decision Latitude	-0.20	0.82 (0.71, 0.95)	6.75 (1)	0.009

* The dependent variables controlled for sex, age, BMI, hormone replacement drug, chronic diseases, exercise, hours use of dental instruments per day, decision latitude and psychological job demand.

The multiple logistic regression is reasonably fit (Hosmer and Lemershow goodness-of-fit: Chi square= 8.39, df=6, p-value= 0.211; overall correctly classified percentage= 78.8%, sensitivity=9.5%, specificity=97.4%; area under Receiver Operating Characteristics (ROC) curve = 0.740; There is no interactions between independent variables in the model.