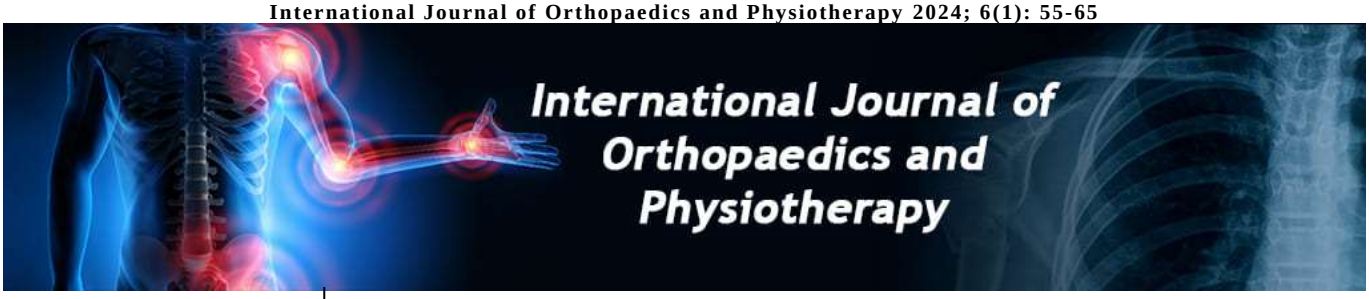

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The prevalence and risk factor profile of carpal tunnel syndrome among computer science and computer engineering students

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Abstract
Background: This study demonstrated if there is any relationship between using a computer for long hours and carpal tunnel syndrome.
Objective: The purpose of this study was to determine if there is any connection between computer use among computer science students and carpal tunnel syndrome.
Methods: In our study sample size was 100 and it's a cross-sectional\ observational study on computer science students and computer Engineering at An-Najah National University all participants in this study completed questionnaires for physical activity, carpal tunnel syndrome, sociodemographic, range of motion, manual muscle testing, sensory assessment, and grip strength by dynamometer between February 2023 and May 2023.
Results: After going through the analysis process, we discovered that participants (55%) were from Computer Engineering (45%) were from IT, (41%) participants were male, and (59%) were female, we noticed that depending on the results there is a relation between long time and carpal tunnel syndrome.
Conclusions: This study showed that students who were spending more time on computers had carpel tunnel syndrome and students should have more knowledge about carpel tunnel syndrome to prevent themselves from complications.

Keywords: Chhani, consumption, fuel-wood, households, Lanchaan

Introduction
CTS (Carpal Tunnel Syndrome) has a higher prevalence rate in occupational groups such as office workers, healthcare workers, service workers, and pregnant women. In some cases, they are more prevalent in women than men [1-2].
The risk factors for CTS, include heavy lifting, repetitive wrist, and hand motion, an increased risk of CTS happens when the hands are flexed or extended. Higher exposure to computer work was found to increase the risk of CTS. The most recent research indicates that people who spend more than 20 hours per week using a keyboard, computer, or mouse for over 4 hours per day may be at increased risk for developing carpal tunnel syndrome. Another study discussed that people who used a computer for 12 hours per day had a nearly 5-fold increased risk of carpal tunnel syndrome [3-8].
Based on scientific articles, carpal tunnel syndrome is a result of increasing pressure on the median nerve. The causes of CTS include obesity, pregnancy, and autoimmune disorders like rheumatoid arthritis. However, most CTS cases are idiopathic. Secondary CTS causes are divided into: Abnormalities of the container; any condition that modifies the walls of the carpal tunnel and causes compression of the median nerve, such as dislocation or subluxation of the carpus, fractures, wrist arthrosis, and inflammatory arthritis. Abnormalities of content; such as tenosynovitis, inflammatory rheumatism, infection, hypothyroidism, and chronic kidney failure can cause carpal tunnel syndrome. Additionally, repetitive wrist extension and flexion movements. Notably, injuries such as fractures or sprains also cause carpal tunnel syndrome [9].
The diagnosis of carpal tunnel syndrome is tightly related to the treatment plan; which can be divided into prevention; for those at a possible risk, and a full treatment plan.

The diagnosis starts by taking the patient's history and the onset of the symptoms like numbness, weakness in his or her wrist and fingers, provocative factors such as hand positions and repetitive movements, working activities like instrument use, and pain assessment which includes location, intensity, type of pain, duration, and alleviating and aggravating factors. After that, start with traditional ways of diagnosis [10-11].

The traditional ways of diagnosis are divided into four parts. The first one is electro-diagnosis; this technique is used to notice abnormalities of the median nerve fibers within the carpal tunnel. It focuses on measuring sensory and motor fiber conduction in the median nerve and comparing it with the radial and ulnar nerves to avoid misinterpretation of abnormal median nerve findings. The Second is the Nerve Conduction Studies (NCS); which are used to look inside the tunnel and observe all the structures and the behavior of the median nerve during different activations and positions of the hand and wrist. The third part is Magnetic Resonance Imaging (MRI) and Ultrasound It is often used to evaluate the point of entrapment post-failure of Carpal Tunnel Release (CTR) surgery and measure the thickening of the median nerve, flattening of the nerve within the tunnel, and bowing of the flexor retinaculum. The last part is the Physical examination, which happens by doing many tests, such as Tinel's test: If there is any tingling in the median nerve distribution, then the test is positive. Phalen's test; The test is positive if the patient feels numbness or tingling throughout the median nerve distribution of the hand within 45 seconds. and Median nerve compression test; A positive test is the reproduction of pain, paresthesia, or numbness distal to the site of compression during the compression in the distribution of the median nerve [10, 12-13].

The management of CTS incidences in patients depends on the severity of the disease. In minor and modest circumstances, a trial of conventional treatment is encouraged for the patients. This includes wrist splints, medications, and the administration of steroids in the affected regions to ease the pain and swelling corticosteroids [14].

Then start with physical therapy: therapeutic ultrasound, acupuncture, neuromobilization, manual therapy, mobilization techniques, massage techniques, and kinesio taping [15-17].

The treatment of carpal tunnel syndrome (CTS) usually involves surgical decompression of the nerve. The doctors recommend surgery when the syndrome's symptoms last more than six months without any relief. There are two kinds of carpal tunnel release surgery, namely, the traditional approach and the endoscopic carpal tunnel release [14].

To identify if the IT or computer science students have a risk factor profile for CTS and to determine if there is a relationship between extended use of laptops or computers and CTS symptoms.

This study hypothesizes that prolonged computer use is linked to carpal tunnel syndrome in computer engineering students at An-Najah National University.

Methods

Research Setting: This study was conducted in the Faculty of Computer Engineering and Information Technology at An-Najah National University in Nablus, Palestine.

Pilot Study: the questionnaires were given on paper to 10 computer engineering and information technology students at An-Najah National University from the third to the fifth years.

Sampling Method

A non-probability, convenient sampling method was used. In the first, the students start with the sociodemographic. After that, a questionnaire that includes: physical activity, carpal tunnel syndrome, and the Boston carpal tunnel questionnaire was used. A variety of tests were done; ROM testing, MMT of participants' upper extremities, sensory examination, and special tests such as Tinel's sign, Phalen's test, carpal compression test, and grip strength by manual dynamometer.

Inclusion and exclusion criteria

Inclusion Criteria

The participant should be a student in their third–fifth year of computer engineering or IT college at A Najah National University. Should use their laptop or computer for long periods of the day. Both genders, male and female, are included in our study.

Exclusion Criteria

Students who are not a student in computer engineering or IT college at A Najah National University. Students whose academic level is first or second year in college students do not use computers for a long time.

Sample Size

The sample size has been estimated to be 0.5 by using the G power program 95% of freedom 5 data were collected from 80 students and then we added 20 students to the expected missing data based on the study: "Bhandari, Dinesh J., *et al*. "Computer use and carpal tunnel syndrome: A case-control study." Indian journal of occupational and environmental medicine 21.3 (2017): 109" [18].

Research Instrumentation

Sociodemographic data consists of 8 items (Name of the student, age, gender, location, college, specialization, academic year, and the number of hours of computer usage per day).

Boston Carpal Tunnel is a patient-reported questionnaire that examines the symptom severity and overall functional status of patients with carpal tunnel syndrome. The Symptom Severity Scale (SSS) with 11 questions is scored on a Likert scale of 1–5, and the Functional Status Scale (FSS) with 8 questions is scored from 1–5, with 1 as no difficulty and 5 as difficult. An ICC value of more than 0.8 An α value equal to, or greater than, 0.70 Construct validity: Spearman r = 0.71-0.90.

Carpal tunnel syndrome is a patient-reported questionnaire. It consists of nine items, and the patient should answer yes, no, or not exist. Reliability: the reliability coefficient was calculated as 0.64, and the α value was 0.80 (95% CI). 28. Validity: The pooled estimates were 0.72. The Spearman correlation coefficient between the satisfaction scale and the items concerning patient opinion was 0.82 (95% CI).

2.6.3. General Practice Physical Activity Questionnaire: It consists of three sections (the type and the amount of physical activity, how many hours they spend on activities, and walking speed). Reliability: The α value was 0.74 (95% CI), and the explained variance rate was 0.38. Validity: The pooled estimate was 0.001.

Goniometer
For ROM to measure any limitation in the upper extremity in all movements and compensate between the right and left hands. Reliability: Spearman correlation between 0.70 and 0.87.

Oxford Scale
For MMT to measure any decrease in muscle strength in the upper extremity in all movements and competition between the right and left hand. Reliability: intra-class correlation (ICC) of 0.897 (0.813–0.942). Validity: (general health r = 0.34) to (physical role functioning r = 0.82).

Dynamometer
(Manual dynamometer 3 test and compare between the right and the left hands) Reliability: ranging from 0.800 to 0.990. Validity: correlation coefficients greater than 0.750.

Special test
(For carpal tunnel syndrome: Tinel's test, Phalen test, carpal compression test) The Tinel's test: a sensitivity of 60%, specificity of 67% Phalen test: a sensitivity of 75%, specificity of 47% and Carpal compression test: sensitivity of 100%, specificity of 97%

Data collection procedure
Many posts were shared on social sites, and the examinations that we would perform were completely explained to the students. The daily examination was carried out in physiotherapy clinics, and then we distributed the questionnaires directly to the patients for 20 minutes per person.

Statistical analysis
The data was analyzed using the Statistical Package for Social Sciences (SPSS), version 21, using descriptive and analytical statistics.

Ethical Consideration: The research proposal was approved by An-Najah National University IRB committee. Participants will be fully informed of the objectives of the study, and it will be ensured that their answers will be treated as confidential, used only for academic purposes, and will be unavailable for five years after the study. We will try to create a comfortable and calm environment in the physical therapy clinics. The participants will have the right to withdraw from the study at any time.

Results
Sample characteristics
The sample includes 100 participants who completed the study from An-Najah University. 55 participants (55%) were from Computer Engineering and 45(45%) were from IT (as shown in Table 1). 56 participants (56%) were in their third, 37 (37%) in their fourth year, and 7 (7%) in their fifth year (as shown in Table 2). 41 (41%) of the participants were males and 59 (59%) were females (as shown in Table 3). The mean age for the participants was 21.3 years (SD = 1.023), ranging from 20-23 years (as shown in Table 4).
- Our study depends on a long duration of using the computer. The participants were asked about their time on the computer per day, The results show that the carpel tunnel syndrome is related to spending more time on the computer. the results are shown in Table (6) below.
The used questionnaire has several parts to measure the student's symptoms and complaints. The initial section of the questionnaire assessed the intensity of symptoms using 11 items. The table below shows the arithmetic averages for each item, arranged according to the percentage of each item's average. It has been found that the highest percentage was (The number of times waking up from hand \wrist pain in the past two weeks) as it's reached (44.25%), while the lowest percentage was (Having difficulty grasping and using small objects such as keys or pens) which reported by 29.8% of the participants as shown in Table (7).
The questionnaire also included special evaluation tests; Tunnel's test, Phalen's test, and Carpal compression test. These tests were performed on both hands for each participant. Table (8) displays the number of participants who had positive and negative results, the mean and SD.
Table (9) shows the average value for each test on each hand.

- Both hands were tested for short and long durations, and the results were compared. Table (9) shows a correlation between prolonged computer use and positive test results. The results indicated a higher positivity rate in cases where computer usage was extended.
- Table (11) and Table (12) measure the relation between the social data and severity of symptoms for participants and the duration of using the computer respectively. The Chi-Square test was used, which is a statistical test that was applied to study the relationship between two variables to see if there is a relationship between them or not. This test was conducted by comparing a value previously determined by the researcher known as the level of significance (alpha) with the value called the p-value calculated from the available data, by comparing the two values whether there is a relationship between the two or not. The table shows that some variables correlate while others do not. The variables that do not correlate, were marked with a different color and the symbol (**).

Correlations
From the table below, the Spearman correlation coefficient can be seen when the sample variables have a weak negative correlation, and there is a weak direct correlation with statistical significance at a significant level ($0.05 \geq \alpha$), between the number of hours using PC and the student's age, where the value of the correlation coefficient between them was (0.200*), and this means that the greater the age of students, the greater the time of using PC. There is also a weak direct correlation with statistical significance at a significant level ($0.05 \geq \alpha$) between the number of hours using PC, and the academic years of the students, where the value of the correlation coefficient between them was (0.202*), and this means that the more the academic years for the student the more time using PC**.**
Spearman's test was done instead of Pearson's test because the population does not follow the natural distribution. Shown in Table (13) below.

Regression

Table 1: Coefficients a Unstandardized Coefficients

		B	SE	Beta	T	Sig.	95% CL		Arrangement
Model	(Constant)	2.792	1.202		2.323	0.022	0.405	5.179	
	The Students' gender	0.178	0.099	0.19	1.799	0.075	-0.018	0.375	1
	The Students' academic years	0.117	0.097	0.165	1.212	0.229	-0.075	0.309	2
	The number of hours of computer use per day	0.032	0.022	0.151	1.472	0.144	-0.011	0.076	3
	The place of residence of the student	-0.01	0.04	-0.027	-0.262	0.794	-0.089	0.068	4
	The students' age	-0.065	0.06	-0.142	-1.073	0.286	-0.184	0.055	5
	The students' undergraduate major	-0.096	0.098	-0.104	-0.98	0.33	-0.292	0.099	6
Dependent Variable: total questionnaire									

Discussion

A published study in January 2015 by Shiri R. and Falah-Hassani K is consistent with our research. According to this meta-analysis study, excessive computer use, especially mouse use, maybe a minor occupational risk factor for CTS. computer/typewriter use ≥ 1 vs. < 1 h/day (OR = 0.63, 95% CI 0.38–1.04) and computer/typewriter use ≥ 4 vs. < 4 h/day (OR = 0.68, 95% CI 0.54–0.87). The more hours and frequency of computer and mouse use, the greater the risk of CTS. But there are some differences. The first is that our study does not target the occupational group or the general public. Rather, it targets students of IT and computer engineering. The second thing is that our students spend time on computers from three hours to twelve hours, and the majority spend six hours, as mentioned before. But (Shiri R, Falah-Hassani K, 2015 Jan 2) was from 1-4 hours. Finally, no comparison was made between the genders in our study. The percentage of women affected by carpal tunnel syndrome is higher than that of men in our study [20].

A study titled "Prevalence and Risk Factors of the Self-reported Wrist and Hand Symptoms and Clinically Confirmed Carpal Tunnel Syndrome among Office Workers" in China 2021, targeted individuals aged between 17 and 49 years, it was conducted across 30 different workplaces. The study collected responses from a total of 969 participants. It showed the results of questionnaires (work-related physical and psychosocial factors and wrist and hand symptoms), the CTS cases were screened based on the history, Phalen's test, Tinel's Test, and skin sensation testing among symptomatic respondents, which is consistent with our research.

The previously mentioned study also revealed that prolonged computer use time and working without breaks were associated with the presence of wrist or hand symptoms (adjusted ORs: 1.11 (95% CI 1.02–1.22) and 1.88 (95% CI 1.12–3.14), but in terms of the academic years, their findings were discrepant with our study results; there was no correlation between the academic years and the presence of wrist or hand symptoms (adjusted OR: 2.20 (95% CI 1.19–4.07)). Moreover, it showed that the prevalence in female workers was higher than male (male workers (=8.4) and female workers (=10.3%) and this is consistent with our research [21].

Another previous study titled Carpal Tunnel Syndrome and its Relationship to Occupation: A Meta-analysis 2007 is consistent with our research. There is a positive relationship between exposures (ReZpetition, force plus repetition, and use of vibratory tools) and CTS. The difference between this study and ours is that we have not tested vibration on participants. Four papers with a high risk of bias were identified and excluded from analyses associated with exposure to repetition and vibration. There was no change to the associated risk of repetition and CTS when excluding three papers with a high risk of bias (OR 2.30; 95% CI 1.76, 3.00; $p < 0.001$). The risk related to vibration exposure decreased slightly but still demonstrated a positive association (OR 2.65; 95% CI 1.83, 3.84; $p < 0.001$) [22].

A study titled Computer Professionals and Carpal Tunnel Syndrome by K. Mohamed Ali and B.W.C. Sathiyasekaran (2006) showed that the longer the time of computer use, the greater the risk of carpal tunnel syndrome. Also, it showed that carpal tunnel syndrome is more prevalent among older people because aging is a risk factor, which was the same in our study.

The only difference between this study and ours is that the prevalence of CTS in males was higher than in females, while our study was the opposite. This has been justified by saying that most of the sample in our study was female (the whole sample size was 100, females 59, males 41), while most of the other study sample was male (the whole sample size was 648, females 117, males 531) [23].

Strengths and Limitations

The study included participants who were students of different ages between 20 and 23, which means that they differed in their academic years. The first limitation was that we couldn't have students from the same academic year. As mentioned earlier, the major group consisted of third-year students, while the least represented group was fifth-year students.

Another limitation was the participant's gender; achieving an equal sample size between males and females has been challenging. The other thing was the external factors; participant's external factors, such as prolonged use of mobile phones in addition to computer usage were beyond the study's control.

On the other hand, the study had strengths. The sample size was considered large and good for such research. Moreover, the dynamometer that was used during the participant's evaluation is a tool with high validity and reliability. Another strength was that the questionnaire had an Arabic copy, which was easy for participants to read, understand, and answer.

Table 2: (The number and percentage of the participant's academic years).

Academic years for student	Third Level.	56	56.0%
	Forth Level	37	37.0%
	Fifth Level	7	7.0%
	Total	100	100.0
Student's gender	Female 59	59%	
	Male 41	41%	
	Total 100	100%	

Table 3: (The numbers and percentage of the participant's ages.)

		Frequency	Percent	Mean	Std. Deviation
The age of the student	20.00	26	26.0%	21.3200	1.02376
	21.00	31	31.0%		
	22.00	28	28.0%		
	23.00	15	15.0%		
	Total	100	100.0%		

Table 4: Able shows the distribution of students based on the number of hours they use a computer per day, with corresponding percentages of students for each usage duration

	Number of hours (n of students)	
The number of hours of computer usage per day	3.00 (1)	1.0%
	4.00 (12)	12.0%
	5.00 (22)	22.0%
	6.00 (24)	24.0%
	7.00 (8)	8.0%
	8.00 (16)	16.0%
	9.00 (2)	2.0%
	10.00 (10)	10.0%
	12.00 (5)	5.0%
	Total (100)	100.0%

Table 6: (The table illustrates the number of hours spent by students which ranges from three to twelve hours. The majority of the participants, which consisted of 24 students, spent six hours using the computer, and only one student spent three hours or less, which was the minimum among all the students).

Table 5: (The arithmetic means and standard deviation of the averages for the students' responses**).**

Part1		Frequency	Percent	Mean	SD
The intensity of hand \wrist pain felt by the student at night	Normal	43	43.0%	2.0100	40.2%
	Little	31	31.0%		
	Moderate	15	15.0%		
	Severe	4	4.0%		
	Very severe	7	7.0%		
	Total	100	100.0%		
Number of times waking up from hand \wrist pain in the past two weeks	Normal	53	53.0%	1.7700	44.25%
	Once	23	23.0%		
	From two to three times	18	18.0%		
	From four to five times	6	6.0%		
	Total	100	100.0%		
The severity of the pain in the hand \wrist during the day	No pain	30	30.0%	2.0800	41.6%
	Little	54	54.0%		
	3.00	4	4.0%		
	4.00	2	2.0%		
	Very severe	10	10.0%		
	Total	100	100.0%		
The number of times during the day the student experiences pain in their hand or wrist.	Normal	43	43.0%	2.1000	42%
	From 1-2 times per day	27	27.0%		
	Moderate	15	15.0%		
	More than 5 times	7	7.0%		
	Continuous	8	8.0%		
	Total	100	100.0%		
The average duration of a pain episode during the day	Normal	45	45.0%	1.8900	37.8%
	less than 10 minutes	37	37.0%		
	from 3-5 times per day	6	6.0%		
	Severe	8	8.0%		
	Continuous	4	4.0%		
	Total	100	100.0%		
The numbness (loss of feeling) in their hand	Normal	36	36.0%	2.0300	40.6%
	Little	40	40.0%		
	From 10-60 minute Continuous	11	11.0%		
	Severe	11	11.0%		
	Very severe	2	2.0%		
	Total	100	100.0%		
The weakness's severity in the student's hand\wrist	Normal	47	47.0%	1.9100	38.2%
	Little	25	25.0%		
	Moderate	20	20.0%		

	Severe	6	6.0%		
	Very severe	2	2.0%		
	Total	100	100.0%		
The tingling severity in the student's hand \wrist.	Normal	41	41.0%	1.9500	39%
	Little	36	36.0%		
	Moderate	13	13.0%		
	Severe	7	7.0%		
	Very severe	3	3.0%		
	Total	100	100.0%		
The intensity of numbness\tingling in the student's hand \wrist at night	Normal	45	45.0%	1.9300	38.6%
	Little	28	28.0%		
	Moderate	19	19.0%		
	Severe	5	5.0%		
	Very severe	3	3.0%		
	Total	100	100.0%		
Number of times waking up from hand\wrist numbness\tingling in the past two weeks	Normal	64	64.0%	1.6400	32.8%
	Once	19	19.0%		
	From 2-3 times per day	9	9.0%		
	From4-5 times per day	5	5.0%		
	More than 5 times	3	3.0%		
	Total	100	100.0%		
Having difficulty grasping and using small objects such as keys or pens	No difficulty	63	63.0%	1.4900	29.8%
	Little difficulty	28	28.0%		
	Moderate difficulty	7	7.0%		
	Severe difficulty	1	1.0%		
	Very severe difficulty	1	1.0%		
	Total	100	100.0%		

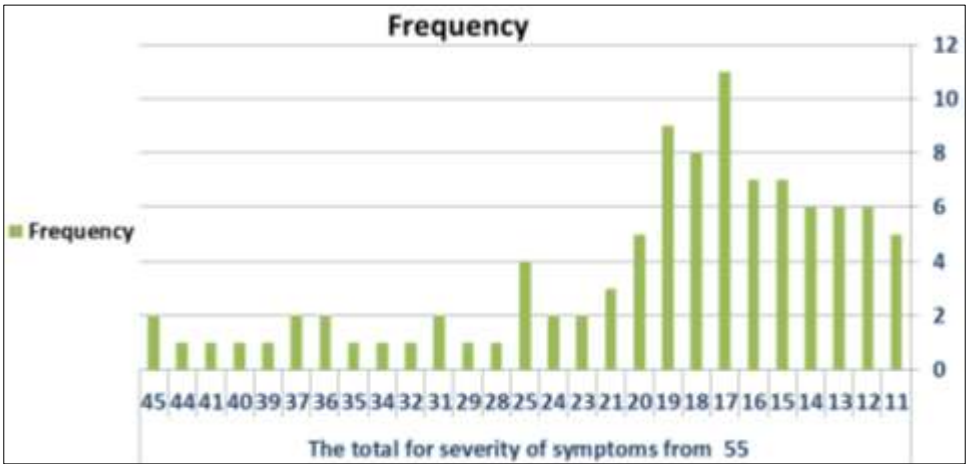

Fig 1: (The total for the severity of symptoms from 55 according to the student's responses).

Table 6: (The arithmetic means, standard deviation, weights, and percentages of the averages for the students' responses).

		Frequency	Percent	Mean	%	Std. Deviation
Special test Tunnel's test right	Positive	38	38.0%	1.6200	54%	.48783
	Negative	62	62.0%			
	Total	100	100.0%			
Special test Tunnel's test left	Positive	30	30.0%	1.7000	56.6%	.46057
	Negative	70	70.0%			
	Total	100	100.0%			
Special test Phalen's Test right	Positive	20	20.0%	1.8000	60%	.40202
	Negative	80	80.0%			
	Total	100	100.0%			
Special test Phalen's test left	Positive	19	19.0%	1.8100	60.3%	.39428
	Negative	81	81.0%			
	Total	100	100.0%			
Special test Carpal compression test right	Positive	33	33.0%	1.6700	55.6%	.47258
	Negative	67	67.0%			
	Total	100	100.0%			
Special test Carpal compression test left	Positive	34	34.0%	1.6600	55.3%	.47610
	Negative	66	66.0%			
	Total	100	100.0%			
					56.96%	

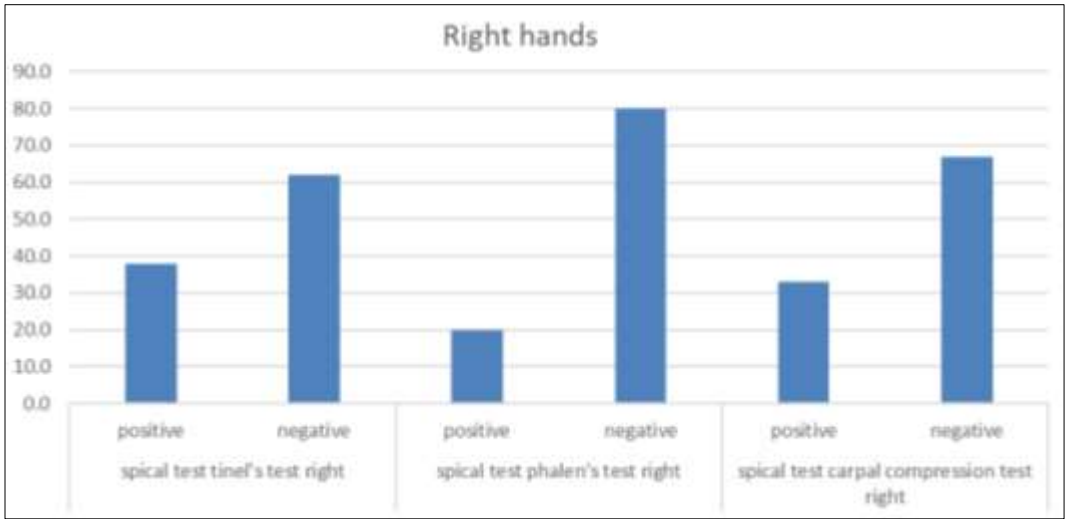

Fig 2: The results of the three tests conducted on participants' right hand.

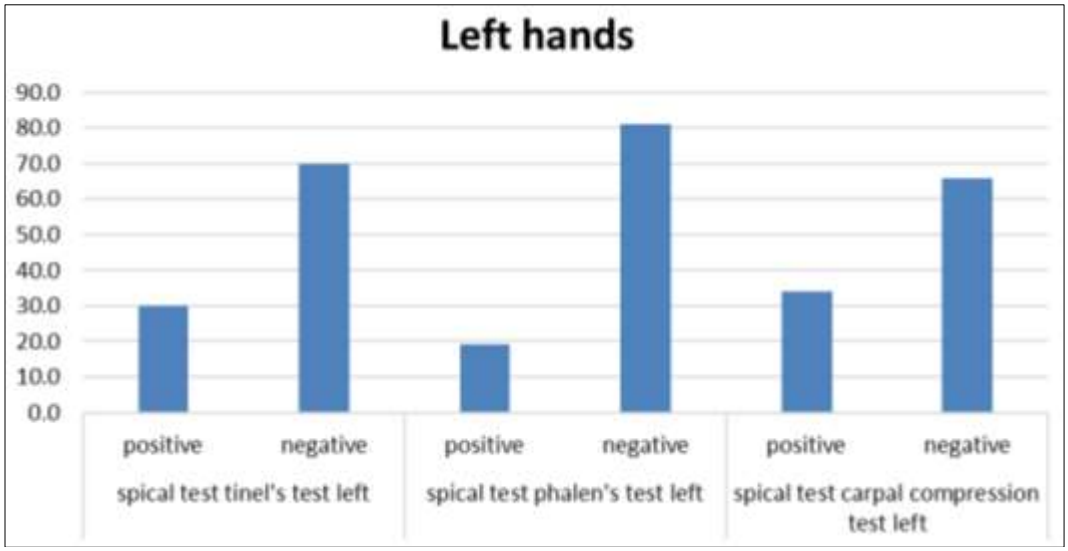

Fig 3: The results of the three tests conducted on participants' left hand.

Table 7: The correlation between the duration of computer usage and the results of special tests.

		Short time	Long time	P values
Special test Tinel's test right	Positive	12	26	0.367
	Negative	23	39	
Special test Phalen's test right	Positive	5	15	0.218
	Negative	30	50	
Special test Carpal compression test right	Positive	10	23	0.322
	Negative	25	42	
Total right	Positive	9	21.33	
Total right	Negative	26	43.66	
Total		17.5	32.45	
Special test Tinel's test left	Positive	8	22	0.181
	Negative	27	43	
Special test Phalen's test left	Positive	5	14	0.274
	Negative	30	51	
Special test Carpal compression test left	Positive	11	23	0.433
	Negative	24	42	
Total left	Positive	8	19.66	
Total left	Negative	27	45.33	
Total		17.5	32.45	
Total		35	65	

The study measured the grip strength of participants using a manual dynamometer. The test was made for both hands with 3 repetitions for each one.

Table 8: (The arithmetic means, standard deviation, weights, and percentages of the averages for the students' responses).

		N	Mean	SD	P values
Manual dynamometer test 1 right	Short time	35	28.43	9.36	0.613
	Long time	65	27.34	10.75	
Manual dynamometer test 2 right	Short time	35	27.00	9.93	0.789
	Long time	65	26.39	11.32	
Manual dynamometer test 3 right	Short time	35	25.71	10.01	0.93
	Long time	65	25.90	11.00	
Total right	Short time	35	27.047	9.76	
Total right	Long time	65	26.543	11.233	
Total		100	26.795	10.4965	
		N	Mean	SD	P values
Manual dynamometer test 1 left	Short time	35	24.56	7.66	0.547
	Long time	65	25.86	11.43	
Manual dynamometer test 2 left	Short time	35	25.12	9.57	0.991
	Long time	65	25.09	10.29	
Manual dynamometer test 3 left	Short time	35	25.35	10.48	0.546
	Long time	65	24.04	10.21	
Total left	Short time	35	25.01	9.236	
Total left	Long time	65	24.996	10.643	
Total		100	25.002	9.9395	

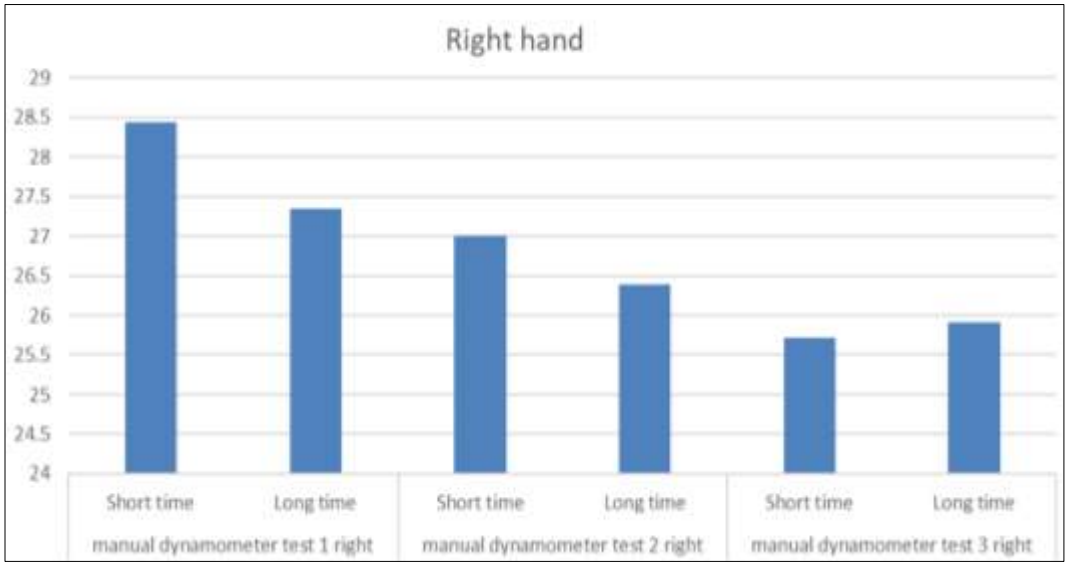

Fig 4: (The dynamometer results on the participants' right hand)

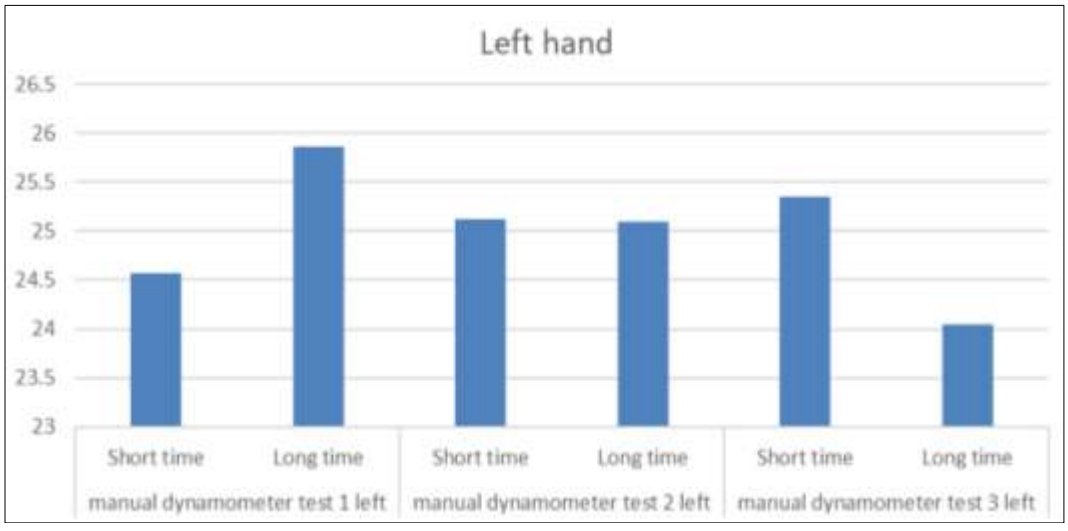

Fig 2: (The dynamometer results on the participants' left hand)

Table 9: The relation between the participants' social data and the number of hours using the computer and the Chi-square test results for it.

		Number of hours using PC			
	Values	**Short time**	**Long time**	**Chi**	**P value**
The Students' age	20	13	13	6.394	0.094
	21	12	19		
	22	5	23		
	23	5	10		
The Students' gender	Male	13	28	0.331	0.565
	Female	22	37		
The Students' residence place	Hebron	3	7	3.598	0.731
	Jenin	1	2		
	Nablus	20	39		
	Qalqilya	5	4		
	Ramallah	2	8		
	Tulkarm	4	5		
The Students' undergraduate major	computer	19	36	0.011	.008**
	IT	16	29		
The Students' academic year	3	24	32	12.126	0.016*
	4	8	31		
	5	3	2		
Total questionnaire	0-3	2	3	3.245	0.197
	3 to 8	30	47		
	8 to 12	3	15		
Total		35	65		

Table 10: Data was collected for students who used computers for both long and short periods of time. The results indicated that the majority of participating students (65%) used computers for a long period, while only 35% used them for a short period

Number of hours using PC					
		Short time	**Long time**	**Chi**	**P value**
Part1: The intensity of hand \wrist pain felt by the student at night	Normal	18	25	3.737	0.443
	Little	9	22		
	Moderate	5	10		
	Severe	0	4		
	Very severe	3	4		
Part1: Number of times waking up from hand \wrist pain in the past two weeks	Normal	20	33	1.646	0.649
	Once	9	14		
	From two to three times	4	14		
	From Four to five times	2	4		
Part1: Feeling pain in the hand or wrist of the student during the day	No pain	11	19	1.685	0.793
	Little	18	36		
	3	2	2		
	4	0	2		
	Very severe	4	6		
Part 1: The frequency of the hand or wrist pain throughout the day?	Normal	19	24	5.532	0.237
	From 1-2 times per day	8	19		
	Moderate	3	12		
	More than 5 times	1	6		
	Continuous	4	4		
Part1: The average time it takes for a pain episode during the day	Normal	20	25	4.432	0.351
	Less than 10 minutes	10	27		
	From 3-5 times per day	1	5		
	Severe	2	6		
	Continuous	2	2		
Part1: Numbness (loss of feeling) severity in the student's hand."	Normal	14	22	12.406	0.015*
	Little	17	23		
	from 10-60 minute Continuous	0	11		
	Severe	4	7		
	Very severe	0	2		
Part1: Weakness severity in the student's hand or wrist	Normal	18	29	2.683	0.612
	Little	10	15		
	Moderate	4	16		
	Severe	2	4		
	Very severe	1	1		
Part1: Tingling severity in student's hand \wrist	Normal	17	24	3.903	0.419
	Little	10	26		
	Moderate	3	10		
	Severe	4	3		

	Very severe	1	2		
Part1:Intensity of numbness\tingling in the student's hand \wrist at night	Normal	18	27	1.629	0.804
	Little	10	18		
	Moderate	5	14		
	Severe	1	4		
	Very severe	1	2		
Part1: Number of times waking up from hand\wrist numbness\tingling in past two weeks	Normal	25	39	15.151	0.004**
	Once	6	13		
	From 2-3 times per day	0	9		
	From4-5 times per day	4	1		
	More than 5 times	0	3		
Part1: Having difficulty grasping and using small objects such as keys or pens	No difficulty	22	41	2.686	0.612
	Little difficulty	9	19		
	Moderate difficulty	3	4		
	Severe difficulty	0	1		
	Very severe difficulty	1	0		
Total		35	65		

Table 11: The correlation between the social data of participants, wrist, MCP, PIP ROM, and the number of hours using the computer. Using Spearman's test

Spearman's rho	Number of hours using PC
Number of hours using PC	1
The Students' age	.200*
The Students' gender	-0.058
The place of residence of the student	-0.053
The Students' undergraduate major	-0.011
The Students' academic year	.202*
Total from55	0.165
Total questionnaire	0.165
Speed	-0.001
Wrist flexion AROM right	0.015
Wrist flexion AROM left	0.039
Wrist extension AROM right	-0.12
Wrist extension AROM left	0.046
Wrist radial deviation AROM right	-0.131
Wrist radial deviation AROM left	-0.025
Wrist ulnar deviation AROM right	0.042
Wrist ulnar deviation AROM left	0.091
MCP flexion AROM right	-0.126
MCP flexion AROM left	-0.011
MCP extension AROM right	-0.023
MCP extension AROM left	0.048
PIP flexion AROM right	-0.092
PIP flexion AROM left	-0.054

Conclusion

In conclusion, the study showed that students who spent more time on computers had carpal tunnel syndrome. Accordingly, research hypothesis H1 is accepted "There is a relationship between long computer use and & tunnel syndrome in computer engineering students at An-Najah National University." The null hypothesis HO is rejected: "There is no relationship between long computer use and carpal tunnel syndrome in computer engineering students at An-Najah National University." So, the affected students should have more knowledge about carpal tunnel syndrome. On the other hand, the rest of the students should know how to protect themselves from this syndrome.

Recommendations

The findings given in this study pave the way for a significant amount of future research. The study can be developed from cross-sectional to experimental research. Then it could have a therapeutic phase. Moreover, it could be helpful for the participants to reduce their pain and alleviate their symptoms. Additionally, an exercise program can be incorporated to enable participants to self-control their pain.

Also, future researchers in this subject are recommended to increase the population sample so it includes other universities in Palestine. Also, increasing the student's awareness and knowledge of the duration of their computer use, the posture of their body and hands while using it, and how to deal with their pain and symptoms is highly recommended.

Author's Contribution

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