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Research

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The Prevalence of Signs of Median Nerve Compression Among College Students in Kinesiology

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ABSTRACT

Purpose: The purpose of this study was to assess the prevalence of signs of Median Nerve Compression (MNC) among male and female college students.
Methods: Forty-one Kinesiology majors, 24 males (58%) and 17 females (42%) completed surveys to assess the volume of physical activity, computer use, and distal upper extremity pain associated with these activities. Each participant was assessed for signs of MNC with the Phalen's test, Tinel's tap test, and the hand elevation test. Grip strength was measured by hand grip dynamometry and participants' percentile norms were calculated.
Results: Indications of MNC were present in 17% of participants, (6 males, 1 female). Fifty-one percent of students experienced computer-related hand and forearm musculoskeletal pain. Eighty-one percent of those had pain during extended computer use and 41% of students experienced occasional pain with physical activity. It is noteworthy that 85% of participants used the computer 4 hours per day or less. Also, with each category of computer use and physical activity, 93% of participants had not experienced pain in the last two weeks.
Conclusion: Though none of these factors could be associated with MNC, the prevalence of symptoms was similar to carpal tunnel syndrome (14%) in the general population.

KEYWORDS: Musculoskeletal; Carpal tunnel syndrome; Computer use.

ABBREVIATIONS: MNC: Median Nerve Compression; MSD: Musculoskeletal disorders; CTS: Carpal Tunnel Syndrome; BMI: Body Mass Index.

INTRODUCTION

The use of information and communication technologies such as desktop, laptop and notebook computers as well as mobile phones has increased dramatically over the last decade and spans all age groups.[1,2] Along with the increase in personal computer use, has been the increase in the number of computers in the workplace. In October 2003, the Bureau of Labor Statistics reported that 77 million persons were using a computer at work.[3] In fact, computers and computer workstations (video display terminals-VDT's) have become commonplace in the work environment over the past 20 years. The increased use of these devices has resulted in reports in the literature linking computer users to an increased risk of upper extremity Musculoskeletal disorders (MSD) resulting from poor postures and working techniques. Prolonged keyboard use in non-neutral working postures with a lack of forearm support increases the risk of MSD[4] while forearm support during keyboard and mouse use has been shown to decrease neck and shoulder muscle activity.[5] Because computers are so widespread, even relatively small risks associated with their use could have important public health implications.[4] Confirming the widespread use of computers, Computer Industry Almanac released a statement in February, 2012 indicating that there were nearly 311 million Personal Computers (PCs) in use in the USA.[6]

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Harris and Straker,[7] in a sample of 271 students, ages 10-17 years, found that 60% reported discomfort with using their laptop computers. Their average daily usage was 3.2 hours with a weekly average usage of 16.9 hours. High school students also reported discomfort after using the computer. In a survey of 382 high school students, 28% reported hand discomfort, 40% reported neck/back pain, 41% reported general body pain and 4% had self-diagnosed or medically diagnosed carpal tunnel syndrome. Jones and Orr further pointed out that high school students are often establishing lifestyle activities and the pattern of increased computer use at a young age may increase the prevalence of injury associated with computer use as the students become older.[8]

Computer use in college is expected and many institutions require students to purchase and use laptop computers[9] that, with improper support of forearm and wrist positions, potentially increases their risk of MSD before they have even entered the work force. Katz et al.[10] surveyed graduating seniors regarding computer-related upper extremity symptoms and reported that half of the graduates had experienced discomfort while using a computer and one in eight reported symptoms after working an hour or less.

Musculoskeletal disorders can result from a variety of factors. In jobs where the work is highly repetitive (flexion and extension) or requires forceful movements of the hands the risk of MSD is high[11] but can also occur with "cumulative trauma".[12] Physical activities such as rock climbing[13] and cycling[14] can also result in MSD and Median Nerve Compression (MNC). One manifestation of MSD is Carpal Tunnel Syndrome (CTS). Carpal tunnel syndrome results when median nerve function at the wrist is compromised by increased pressure in the carpal tunnel and these pressures are increased by wrist flexion, extension and finger extension.[15] The incidence of occurrence in the general population has been shown to range from 14.4%[16] to 16.6%.[17]

The tremendous increase in computer use for work, school, and leisure time with its potential for MSD has led to investigations to minimize or prevent injury. Robertson et al.[18] involved college students in solving computer workstation ergonomic problems to help reduce injuries. Exercise programs have also been utilized as prevention for MSD and CTS. Nathan et al.[19] evaluated subjects before and after a 10 month aerobic exercise program which resulted in significant increases in aerobic fitness and decreases in body composition as measured by Body Mass Index (BMI) along with a tendency to decrease symptoms associated with CTS. Nathan and Keniston[20] also found that the prevalence of median nerve conduction abnormalities and hand/wrist symptoms to be inversely correlated with the frequency and intensity of self-reported exercise. With reports that physical activity levels are associated with fewer symptoms of MNC and CTS and it is assumed that Kinesiology majors will generally, be more active than most college students, the purpose of this study was to assess the prevalence of signs of median nerve compression among male and female Kinesiology students.

METHODS

Subjects

Forty-one students, 24 males (58%) and 17 females (42%), participated in this study. All students were Kinesiology majors with a mean age of 22.5 years ±3.4 (Table 1). The procedure, risks, and participants' rights were verbally explained, and all students signed an institutionally approved informed consent document. Since this study was an exploratory analysis of the relationship between computer use and Kinesiology students who are highly physically active an a-priori power analysis was not performed. Our sample size of 41 was a convenience sample for exploratory analysis.

	Mean	SD	Max	Min
Height	170.4	±9.1	73	59
Weight (kg)	70.6	±12.8	98	52
BMI	24.2	±3.0	29	19
Age (yrs)	22.5	±3.4	33	18

Table 1: Demographics of the participants (n=41).

PROCEDURE

Surveys were used to determine the volume of computer use and physical activity among students, as well as the pain associated with these activities. A series of provocative nerve tests was used to determine the presence of median nerve compression. Each participant was also tested for grip strength through hand dynamometry.

Surveys: Physical activity level was assessed based on the STEPS Instrument survey by the World Health Organization[21] STEP wise approach to chronic disease risk factor surveillance. Participants were asked both how many days in a typical week and how much time on a typical day they participated in moderate and/or vigorous physical activity. Examples for vigorous activities included running and football while examples of moderate activity included cycling, swimming and volleyball.

The prevalence of forearm, wrist, and/or hand pain associated with physical activity and computer use was obtained from another survey.[22] Questions included, "Have you ever experienced pain or discomfort in your hands, wrists, or forearms during or after working on a computer?" Additional questions were included to determine if they had experienced the same symptoms during or after exercise and whether they had experienced these symptoms in the last two weeks with either activity. Participants were asked to report current course workload hours, how many hours in a typical day they used a computer, and what sports activities, if any, they participated in.

Special tests: Following careful study of the guidelines for conducting Phalen's and Tinel's tests as well as repeated practice for consistency, all of these tests were conducted by

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one of the authors (B.B.). Indications of median nerve compression were based on a positive Phalen's test, or a positive hand elevation test. Tinel's tap test was included in the series of special tests, but, by itself, was not considered sufficient to identify median nerve irritation.[15] Though Phalen's test and Tinel's test are commonly used to identify median nerve compression, they can be influenced by examination technique, especially Tinel's.[15,23] Therefore, the hand elevation test, which has a high inter-rater reliability, was additionally used to identify the presence of nerve compression.[15] A modified Phalen's test, as described by Meek and Dellon[24] was used to reduce flexion at the elbow and increase comfort during testing. Tinel's test was performed by tapping for three sets of five strikes over the carpal tunnel, as described by Lifchez et al.[23] The tests were considered positive if neurological symptoms developed in the median nerve distribution of the hand within one minute.[25] The sensory distribution of the median nerve includes the palm of the hand and the lateral 3½ digits[26] For this study, if symptoms were elicited in at least one of the first three digits or throughout the hand, they were considered positive for median nerve compression.[15] Participants who experienced symptoms of pain, paresthesias, and numbness only in the ulnar nerve distribution of the hand, or digits 4, 5 and the ulnar aspect of the palm, were not considered positive for MNC.[27]

Grip strength: Takei hand dynamometers were used to determine grip strength and measurements were reported to the nearest 1 kg. The subject held the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer was adjusted as needed so the base rested on the first metacarpal (heel of palm), while the handle rested on the middle of four fingers. When ready the subject squeezed the dynamometer with maximum isometric effort which was maintained for about 5 seconds.[28]

The results of three trials of the dominant hand were averaged and ranked according to percentile. Normative data for grip strength was based on consolidated reference values compiled by Bohannon et al.[29]

STATISTICS

All participants were included for the analysis of MNC prevalence. Prevalence was determined by the percentage of students positive for MNC signs. Also, prevalence was divided by gender. Binary logistical regression analysis was used to determine if gender, the amount of computer use, physical activity, or pain associated with these activities could predict MNC in students. SPSS 18.0 software was used for analysis and the alpha level for significance was set at $p \leq 0.05$.

RESULTS

Demographics of the participants are presented in Table 1. Most students (88%) reported a course workload of at least nine credit hours (Table 2). Time spent on the computer during a typical day was four hours or less for 85% of respondents and at least three of those four hours were spent during work related to college courses. Computer use on desktop or laptop was not differentiated. Students were asked if they ever experienced pain or discomfort in their hands, wrists, or forearms during or after computer use. Forty-nine percent stated that they never experienced symptoms while 41% reported pain with extended computer use. Four respondents (10%) indicated pain with short-term computer use. Students reported a wide range of physical activity levels (1.5 to 52 h/week) which were categorized as vigorous (7.0 ± 6.8 h) and moderate (4.3 ± 4.9 h). The most frequent physical activity reported was aerobic and included running, walking, cycling, or swimming. Only three of the participants were sedentary and most engaged in physical activity at least three hours per week (85%). Twelve percent of students exceeded 15 hours per week.

		Number of participants (%)
Gender	Male	24 (58)
	Female	17 (42)
Course workload hours	1-4	0 (0)
	5-8	5 (12)
	9-12	14 (34)
	13+	22 (54)
Reported hours/day on computer		
	0-2	18 (44)
	2-4	16 (39)
	4-6	6 (15)
	6-8	0 (0)
	8+	1 (2)
Reported hours/week of physical activity		
	1-5	10 (24)
	5-10	17 (42)
	10-15	6 (15)
Number of sedentary students	15+	5 (12)
		3 (14)
		41

Table 2: Characteristics of participants.

To assess pain associated with physical activity, participants were asked if they ever experienced pain or discomfort in their hands, wrists or forearms during or after physical activity. Fifty-four percent reported that they never did, 41% stated they did occasionally, and two respondents answered that they often did. No student reported that they always had pain during or after activity. With each category of computer use and physical activity, 93% of participants had not experienced any pain or discomfort in the distal extremities in the last two weeks. Grip strength was ranked according to percentile norms, and 71% of participants were in the 80th percentile or higher, while 29% ranked between 50th and 79th percentile. No students were below the 50th percentile. Seventeen percent of students were positive for median nerve compression. Students were asked

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to specify in which area of the hand they experienced symptoms, and were assisted by means of a nerve distribution diagram of the hand. Although time to onset of symptoms was not considered in the analysis, most students required over 30 seconds to produce symptoms. There were not a significant relationship between positive median nerve results and factors such as gender, grip strength, computer use, physical activity level or pain.

DISCUSSION

This study represents a small, exploratory investigation into the prevalence of wrist pain associated with computer use in Kinesiology majors. Seventeen percent of respondents were positive for MNC, which is similar to population prevalence for symptoms of CTS.[16,17] However, six out the seven students with positive MNC results in this study denied any forearm, wrist or hand pain in the two weeks prior to completing the survey. Participation in moderate and/or vigorous physical activity by most subjects in this study may account for a low incidence of pain despite testing positive for MNC. Other studies have evaluated physical activity and the presence of CTS symptoms. Nathan et al.[19] assessed 30 volunteers symptomatic for CTS before and after a 10-month program of supervised aerobic exercise. Besides changes in body fat and peak oxygen consumption, they found that aerobic exercise alleviated hand symptoms associated with CTS, such as pain and tightness. Omer at al.[30] separated computer operators diagnosed with CTS into two groups and provided one group with strengthening and range of motion exercises for the neck, shoulders, and wrists for eight weeks. They observed a lower incidence of pain in the exercising group, while no changes were seen in the control group.

Students were asked in what type of sports activities they participated in, if any. Of the seven students with MNC symptoms, three responded to the question. Two of the students listed weightlifting. Other sports activities listed were football and basketball (in combination with weightlifting), and baseball. In a review of peripheral nervous system injuries in sports, weightlifting and football were listed as activities associated with median neuropathy at the wrist, while baseball has been associated with median nerve neuropathy at the pronator teres.[31] Though not statistically significant, students in this group may have experienced median nerve compression symptoms due to the type of sport or recreational activities in which they regularly engaged rather than computer use.

The relationship between CTS and computer use in the work environment was evaluated in a recent review. Mediouni et al.[32] conducted a meta-analysis to determine whether computer use could be a risk factor for CTS and thus, should be recognized as an occupational disease. While many factors are involved in computer work exposure, time on the computer (> 12 h/day) and bad ergonomic conditions may be associated with increased CTS risk. The finding that ergonomics can play a role in CTS was supported by Liu et al.[33] who found that wrists position while typing on a computer keyboard increased the risk of developing CTS.

CONCLUSION

In the present study, none of the examined factors could be associated with median nerve compression results. The prevalence of MNC neurological symptoms for participants in this study was similar to that of the symptoms of carpal tunnel syndrome reported in the general population (14%). Males had a higher incidence than females for median nerve compression, although this was not statistically significant. Limitations in this study include a small sample size and interpretation of nerve compression distribution patterns. Students were assisted by hand diagrams to choose the nerve distribution that most closely, but may not have exactly, matched their symptoms. This study was also limited in the evaluation of median nerve function, and did not take into account compression distal to the wrist, or include other types of testing, such as nerve conduction studies. Future research should include a larger sample size, and should evaluate students with a high volume of computer use, such as engineering or computer science majors, and should include questions regarding video game participation. Upper extremity nerve compression across specific athletic disciplines of younger age groups would also be worth future study along with workshops to educate students, at any level, about the proper ergonomics when using a mouse and computer keyboard.

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