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# A literature review of neck pain associated with computer use: public health implications

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*Prolonged use of computers during daily work activities and recreation is often cited as a cause of neck pain. This review of the literature identifies public health aspects of neck pain as associated with computer use. While some retrospective studies support the hypothesis that frequent computer operation is associated with neck pain, few prospective studies reveal causal relationships. Many risk factors are identified in the literature. Primary prevention strategies have largely been confined to addressing environmental exposure to ergonomic risk factors, since to date, no clear cause for this work-related neck pain has been acknowledged. Future research should include identifying causes of work related neck pain so that appropriate primary prevention strategies may be developed and to make policy recommendations pertaining to prevention.*
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KEY WORDS: neck pain; human engineering; environment and public health

*L'usage prolongé d'ordinateurs durant les activités professionnelles et récréatives quotidiennes est souvent considéré comme une cause de douleur au cou. Cette revue de la documentation souligne les aspects relatifs à la santé publique des douleurs au cou liées à l'usage d'un ordinateur. Bien que certaines études cas-témoin appuient l'hypothèse selon laquelle l'usage fréquent d'un ordinateur est en lien avec les douleurs au cou, peu d'études de cohorte établissent un lien entre ces deux éléments. Plusieurs facteurs de risque sont mentionnés dans la documentation. Les principales stratégies de prévention se limitent en général à limiter l'exposition environnementale aux risques concernant l'ergonomie, car jusqu'à présent, aucune cause précise de cette douleur au cou associée au travail n'a été reconnue. Les recherches futures devraient se concentrer sur l'identification des causes de la douleur au cou associée au travail afin que des stratégies de prévention appropriées soient élaborées et que des politiques préventives soient recommandées.*
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MOTS CLÉS: douleur au cou; ergonomie; environnement et santé publique

## Introduction

Work-related musculoskeletal disorders (WRMSD)[1] are injuries or disorders of musculoskeletal tissues associated with workplace risk factors and are known by a variety of terms, including cumulative trauma disorders, repetitive strain injuries,[2] and overuse injuries.[3] For people who spend a great deal of time using computers, WRMSDs of the neck are a common problem.[4,5] The term work-relat-

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ed neck pain (WRNP) is employed in this article; "computer" refers to desktop and laptop or notebook personal computers, video display units, and video display terminals, to include the use of keyboards and pointing devices (i.e., mice, trackballs).

Neck pain is defined in this paper as pain experienced from the base of the skull (occiput) to the upper part of the back and extending laterally to the outer and superior bounds of the shoulder blade (scapula). Epidemiological evidence appropriate to WRNP associated with computer use is reviewed; individual, social, behavioral, and psychological issues relevant to WRNP are presented; and preventive and health policy strategies that may be considered to assist in controlling the problem of WRNP are suggested.

## Methods

PubMed and CINAHL were searched from the earliest dates of inclusion through September 2007. Search terms included "neck pain," along with the following Boolean operators: computer, video, video display terminal, VDT, video display unit, VDU, workstation. Coinciding with the receipt of the journal referees' comments regarding the present paper, the results of the Bone and Joint Decade Task Force on Neck Pain[6] were released and reviewed for relevance to the current work. Papers were excluded that did not pertain to neck pain associated with the use of a computer; were not English language sources; and were not from peer-reviewed publications. References from the papers located were also used.

## Discussion

### Etiology

WRNP is a common problem for office computer workers,[5,7,8] especially since an upward trend for computers use can be seen each year. Today, a large number of people use computers for work and recreation, taking up a great deal of their time each day. While part of the increased usage is cultural adaptation to the convenience of new technology, over the past decades an industrial shift to a service-oriented economy has occurred,[9] bringing with it more sedentary jobs.[10] Compounding this shift, the downsizing of the number of employees as a means to minimize losses in corporate profits often results in an increase in productivity for those who remain with a company.[11] Concomitant with downsizing, an increase in sick leave used for musculoskeletal disorders has been noted.[11]

Companies attempt to minimize inefficiencies in the workplace by recuperating time lost with wasteful tasks; computers are a useful tool for this streamlining effort, as office workers no longer need to leave the desk to retrieve mail, or copy or file documents.[12] The increase in productivity and elimination of inefficiencies pertinent to specific tasks, however, also reduces the number of restorative work breaks available to a worker from repetitive or static job tasks.[11]

While an association between the increased use of computers and WRNP has been observed, it is unknown if this is a causal relationship, as few prospective studies have been conducted to investigate this phenomenon. In the absence of obvious pathology, such as arthritis or trauma, the origin of neck pain is still not definitively known, but it is thought to be multifactorial.[6,13] The complex etiology of neck pain includes physical, psychological, individual, and environmental factors.[14]

### Incidence

Since most investigations regarding neck pain and computer use are retrospective, it is difficult to estimate the number of new cases of neck pain ascribed to computer use. More data is available on the general population. The one year incidence of neck pain in the 18–75 year old general population of the United Kingdom has been reported as 17.9% (95% CI 16.0–19.7).[15] For cases not due to whiplash associated disorders, Hogg-Johnson et al[16] have summarized the incidence based upon a best evidence synthesis and report incidence rates in the general population ranging from 15.5–213 per 1000 person years. The incidence of WRNP in computer users ranges from 23.5% for a six month incidence[17] to an annual incidence of 34.4% (95% CI 25.5–41.3).[18] In a most recent systematic review, office workers and computer users experienced the highest incidence of neck pain of all workers with reported incidences ranging from 36 to 57.5 per 100 worker years.[9]

### Prevalence

Numerous studies have presented prevalence data, which are as varied as the samples and time frames studied. For neck pain in the general population, the lifetime prevalence has been reported to be greater than 70%,[4] 67%,[19]

and 80%,[17] respectively. The one year prevalence of neck pain among adults ranges from 12.1% to 71.5%.[16] The point prevalence of neck pain is reported to be between 12 and 34%.[4] The weekly prevalence of neck and shoulder pain in adolescents rose from 17 to 28% in the years 1989 through 1996 in one study; the authors opine that this was related to the increased sedentary nature of adolescents, including increased computer use.[20] An increased prevalence of musculoskeletal illness for users of computers and video display units has been observed;[21,22] Cagnie et al[4] reported a 12-month prevalence of neck pain in office workers of 45.5%. Cote et al[9] more recently reported the one year prevalence of neck pain in office workers to range from 17.7% to 63%.

## Significance

It is important to consider the public health and financial implications of neck pain. Chronic neck pain patients use the health care system twice as often as the rest of the population.[13] It has been estimated that in the Netherlands, the total yearly cost of neck and upper limb symptoms due to decreased productivity, sick leave, chronic disability for work and medical costs is 2.1 billion euros (868 million USD).[2] Over a decade ago, the National Institute for Occupational Safety and Health[23,p.23] estimated that the cost associated with WRMDs was $13 billion annually; more recently, this was projected to be between $45 and 54 billion.[24] With children being exposed to computer-related activities at ever-earlier ages, the health of the future workforce deserves contemplation. Frequent computer activities are an independent risk factor (OR = 1.8) for adolescents using computers four to five hours per day.[25] Since it is known that psychosomatic symptoms during adolescence can predict neck pain in adulthood, Siivola and colleagues state,[20,p.1662] "Symptoms in adolescence may predict morbidity in adulthood." Viewing this as a consequence, future workers could be "sick" before they enter the workforce.

## Dimensions of Health

### *Individual Dimensions*

Several independent individual risk factors exist for WRNP. What is clear is that women are at a greater risk to develop WRNP, evidenced by a plethora of studies summarized by Cagnie and colleagues,[4] Korhonen and colleagues,[18] and Hogg-Johnson et al.[16] Female computer users have almost twice the odds of acquiring WRNP than men (OR = 1.95, 95% CI 1.22–3.13).[4] In one study, individuals age >30 years are more than twice as likely to have WRNP (OR = 2.61, 95% CI 1.32–3.47) as those younger;[4] however, a more recent systematic review suggests that neck pain peaks in the fourth to fifth decade and then plateaus.[9] Smoking is also a risk factor for neck pain.[16] Further work is needed in determining social disparities in WRNP. One study suggests that people with the least desirable occupations are more likely to suffer from neck pain,[26] however, how or where sedentary computer use fits into the schema of 'desirable' is unknown. Unlike diseases such as cardiovascular disease that are more prevalent in minorities, those with less education and in people of a lower socioeconomic class,[27] there is little, if any, such relationship between these factors and WRNP.[9]

A clear relationship exists showing that workers with a prior history of musculoskeletal neck, low back or upper extremity pain are more likely to experience neck pain.[9] People with the most severe neck pain also are more likely to have comorbidities that significantly effect their health.[28] Recent investigations suggest that a person's perception of neck muscle tension is an individual risk factor for WRNP. Wahlstrom and colleagues[14] discovered that men and women who perceived muscular tension in the neck a few times a week had an incidence rate ratio of 1.9 for neck pain, compared to those who did not perceive muscular tension, and this relationship remained when other independent risk factors were controlled. This was supported by another study that showed that the upper trapezius muscles in computer workers with WRNP had less relative rest time during psychologically stressful tasks.[29]

### *Environmental Dimensions*

In the late 1990s, the preponderance of research activity focused on environmental contributors to WRNP and other repetitive stress disorders. From this period of inquiry, much was learned. It was thought, initially, that if the environment could be maximized for the worker, that the prevalence of WRNP would decrease. While this was not realized, a great deal of knowledge pertaining to workstation ergonomics was produced; these studies are the evidence that support recommendations available

from the National Institutes for Occupational Safety and Health,[30] the Department of Defense,[31] and other agencies regarding computer workstation environments. Once environmental variables were minimized, it allowed researchers to see that other variables existed.

While industry found that computers provided immeasurable efficiencies in the work environment, biomedical researchers discovered that there is almost double the risk for developing neck pain for people who spend 95% of their day or more sitting at work (crude RR = 2.01, 95% CI 1.04–3.88).[32] Physical workstation design and task demands, such as duration of computer use, frequency of breaks, method of keyboard operation, position of computer monitors, type and use of input devices are associated with WRNP.[8,18] The slouched posture of computer users has been studied; the slumped forward posture with associated neck flexion is exaggerated when people use notebook and subnotebook computers, compared to desktop computers, and the viewing distances related to using the smaller computers is diminished, thereby worsening posture.[33] Only recently, has it been shown (beyond the hypothetical) that workplace risk factors actually include all of the physical demands imposed during task performance, such as posture, force, frequency and repetition of movement, task duration and vibration experienced.[34]

### *Behavioral Dimensions*

As reasonable as the environmental intervention model seemed, there was no dramatic difference in WRMSDs. Despite improvements in office furniture and ergonomics, many workers continued to have WRNP.[12] Hence, a focus emerged that embraced work task variation and adequate rest from repetitive activities or static postures.[11] Research has clearly shown that static postures associated with computer use are an occupational risk factor.[7] Frequently sitting for a long time is associated with twice the chance of having WRNP (OR = 2.06, 95% CI 1.17–3.62).[4] Compared to having no-load work (sitting), workers who had light-load work were less likely to have WRNP (OR = 0.10, p = 0.023).[17] More specifically, WRNP is about twice as likely for those sitting with the head in a flexed position (OR = 2.01, 95% CI 1.20–3.38),[4] a relationship that has been evaluated at 20 degrees (crude RR 1.62, 95% CI 0.85–3.09) and 45 degrees of neck flexion.[32] Increased neck flexion angles are associated with increased upper trapezius muscle activity and with neck and shoulder discomfort in office workers.[7]

Researchers who investigated the relationship of activity and neck pain found that being passive during leisure time (e.g., watching television) was associated with an increased prevalence of neck pain.[20,35] Being physically active during leisure time reduces the odds of experiencing upper body WRMSDs (adjusted OR = 0.84, 99% CI 0.75–0.95)[10] and is associated with almost twice the odds of not having neck pain (OR = 1.85, 95% CI 1.14–2.99).[4] The concept of 'minibreaks,' or 'microbreaks' surfaced when people realized that optimal ergonomic structure was inadequate to combat WRMSDs. Menzel[36] determined that frequent microbreaks of 30 seconds once every 20 to 40 minutes were an effective means to reduce WRNP and that these microbreaks had no adverse effect on worker productivity.[36]

### *Psychological Dimensions*

Several studies have shown that people with higher mental stress are at a higher risk for WRNP.[18,30] Work situations that demand the greatest job strain,[9,36] least amount of control over the job,[37] and low supervisory support[9,36] are related to an increase in WRNP.[38] People with more perceived job control have less WRNP (OR = 0.86, p = 0.031).[17] Having a shortage of personnel in the workplace is associated with WRNP (OR = 1.71, 95% CI 1.06–2.76).[4] Those with mental tiredness at the end of the day are twice as likely to have WRNP (OR = 2.05, 95% CI 1.29–3.26). [4] Fatigue and sleep difficulties in adolescence are associated with a high prevalence of neck pain in adulthood,[20] suggesting that more attention may need to be directed to the younger population to prevent morbidity in adulthood.

## Prevention

### *Primary Prevention*

Primary prevention has been defined as health promotion and specific protection to a community.[39,p.91] Primary prevention reduces the incidence of disease and is directed toward susceptible people before they develop a disorder.[40] With this in mind, engaging computer users in physical activity as part of their work day would likely be an appropriate primary prevention strategy.[4] Encouraging participation in active leisure activities may have the greatest

effect in sedentary workers.[35] Physical activity may facilitate mechanical and metabolic processes that are health enhancing or healing for musculoskeletal tissues.[10]

Ensuring that computer workstations are arranged to reduce neck flexion (use of document stands, screen height, etc.), use of appropriate chairs, and using rest breaks may help to prevent WRNP.[4,17] Further, while merely providing ergonomic office equipment may not reduce the prevalence of WRNP,[9] providing ergonomic counseling has been shown to reduce WRNP in computer users[41] and may be a useful primary prevention strategy. On a more global scale, preventive measures, such as smoking cessation programs for female computer workers over the age of 30 (those most likely to have WRNP), may be an effective means to lower the incidence and prevalence of WRNP, and would be a fertile ground for research.

Organizations/employers can engage in prevention efforts. Some organizations purchase solely laptop computers for their personnel who often travel. Providing docking stations and external keyboards may have a preventive effect on WRNP. Safety officers can use a screening process to improve workplace safety and health. David and colleagues[34] have developed, validated, and established inter-rater reliability for a rapid worksite tool to assess exposure to risk factors for WRMSDs. Dubbed the "Quick Exposure Check," this brief assessment tool analyzes exposure to environmental, behavioral, physical, and psychological occupational risk factors.[34]

### *Secondary Prevention*

Secondary prevention is usually geared toward preventive measures for people in a population who have developed a disease, yet remain asymptomatic. Thus, secondary prevention aims to reduce the consequences of the disease.[40] With WRNP, the prevention spectrum essentially skips from primary prevention to tertiary prevention (asymptomatic to symptomatic). The only way to implement a secondary prevention program for WRNP would be to identify individuals with known pathology (e.g., rheumatoid arthritis, osteoarthrosis) who are asymptomatic and apply an intervention. Unfortunately, few, if any, preventive strategies are available today for the presence of these conditions in the cervical spine and no valid screening procedures are in place.[40,p.471] Further, even if it were possible to screen for such diseases, it is unknown if they have a direct relationship to neck pain. For example, at present, there is no evidence to suggest that cervical degenerative disease is a risk factor for neck pain.[6,9,16]

### *Tertiary Prevention*

Tertiary prevention is directed at preventing disability in people who have a symptomatic disease in an effort to prevent disease progression or to offer rehabilitation.[40] Providing ergonomic counseling to computer users with WRNP may help to reduce morbidity associated with the disorder. As previously mentioned, people with current WRNP may find reduction in symptoms by engaging in leisure time exercise.[10] Strength and endurance training of the neck muscles, which has been shown to decrease pain and disability in women with chronic neck pain (albeit not computer users), may be helpful for computer users with WRNP and would be an interesting area for further investigation.[13] To support this argument, it is worth noting that Szeto et al[42] demonstrated in a sample of computer users that workers with WRNP had a lower myoelectic signal of the cervical erector muscles and higher signal from the upper trapezius, compared to workers without WRNP. Thus, the use of neck muscle exercises may be a useful tertiary prevention approach to reduce morbidity and to rehabilitate workers. Verhagen and colleagues[43] have found limited evidence for the effectiveness of manual therapy as an add on treatment to exercises and this too would seem to be an area of particular interest to chiropractic researchers.

## Public Health Policy Implications

In order to make changes conducive to preventing WRNP in computer users, the organization/employer must be engaged in the process of change.[44] An important factor to consider is that individuals in control of corporate budgets must be advocates for workplace safety and injury prevention.[44] Adverse health and safety inspections may be one way to motivate companies or organizations to initiate change.[44] Attention to the physical work environment should be a central focus.[18] Further, the empowering of employees to responsibly use microbreaks or to encourage workers to engage in physical activity during the workday to avoid static postures and repetitive activities may well be a beneficial policy.

Psychosocial influences should be heeded; employers may be able to reduce WRNP by (1) increasing the collective decision making of employees, thereby increasing

workers' control over the job environment, and (2) insuring that workers have support from superiors when making decisions.[36]

In addition to the work environment, interventions for WRNP may need to be focused on specific groups. For example, some companies promote the use of alternative therapies that endorse relaxation and a general sense of well being. Strategies that aim to lower perceived muscular tension may only be effective for lowering or eliminating WRNP for those workers who perceive muscular tension in the neck several times per week.

## Conclusion

While it is known that computer users have WRNP, the cause is still an enigma. Future clinical research in this area should be prospective in design, evaluate effectiveness, efficacy, and cost effectiveness of primary preventive strategies for WRNP, and further explore the potential adverse effects of engaging in prolonged exposure to computer work at a young age. There is a need for policy research in this area.

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# Research Capacity Scan

Dear Colleague,

The Canadian Chiropractic Research Foundation (CCRF) is undertaking a survey of all chiropractors in Canada to scan the profession's research capacity. This information is very important for many reasons and will allow the CCRF to set a strategic planning exercise in place to address our future needs in terms of our ability to conduct research.

Please complete the following questions; the survey should take approximately two minutes to complete. Any identifying information that you provide will be used for internal purposes only.

Thank you for taking the time to assist the CCRF. Your input is most appreciated.

Best Wishes,

Dr. Kent Stuber BSc, DC, MSc
Dr. André Bussières DC, FCCS (C), PhD (student)
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**Please respond to these questions:**

1. What is your name? _____
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3. Which province do you live in? _____

4. Are you a candidate for a Masters or PhD (Masters/ PhD/ /No)? _____
- If so, at which University? _____
5. Do you hold a Masters degree or PhD (Masters/ PhD /No)? _____
6. Are you a Faculty member at a university or chiropractic college (Yes/No)? ____
- If Yes, at what university / institution? _____
7. Are you currently completing a post-doctoral (PhD) fellowship (Yes/No)? _____
- If Yes, at which university? _____
8. Do you hold or are you currently a student for another professional degree (ie MD or DDS, etc) (Yes/No)? _____
9. Are you currently engaged in chiropractic research (Full time / Part time / No)? __ _____

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