IT kids: exposure to computers and adolescents' neck posture and pain

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Abstract

Musculoskeletal disorders such as neck pain have been related to computer use in adults and an association between computer use, neck posture and neck pain has been suggested. Computer use in increasing in children and thus the potential for related neck pain and postural changes is increasing. This study evaluated the neck pain, neck posture and computer use of 884 adolescents. Over one third (38%) of adolescents reported using computers for > 7 hours per week, with 4.5% reporting > 21 hours per week. Nearly one half (46.7%) reported ever having neck/shoulder pain, with 7.7% reporting chronic neck/shoulder pain. Computer use was related to neck/shoulder pain and to neck/shoulder postures. Adolescents who reported no use of computers or high use of computers were about twice as likely to report neck/shoulder pain as those who reported moderate use of computers (Odds Ratio = 1.79 and 2.51 respectively). Increasing computer use was related to increased head, neck and thorax flexion during usual sitting (rho=0.069, 0.067 and 0.129, p<.001 respectively). The results demonstrate neck/shoulder pain is a significant problem in adolescence and the potential impact of computer use needs exploring with longitudinal studies.

Keywords: Neck pain, neck posture, adolescents, computer use

1. Background

Children start using computers at an early age. We recently reported that over half of Western Australian children used a computer by 5 years of age [1]. In earlier reports, 99% of Australian children between the ages of 11 and 14 had used a computer [2].

Not only are the majority of children in affluent countries using computers, they experience substantial exposure to computer use by the end of adolescence. In a meta-analysis of studies mainly from Europe and North America, Marshal et al. [3] found the mean daily exposure to computers to be 34 minutes. More recent data suggests this is rising rapidly, with USA children now spending in excess of 60 minutes a day with a computer [4].

Concerns have been raised that the increased use of computers may be influencing the development of adolescent musculoskeletal systems [5,6]. In children, departures from normal sitting postures have been observed with computer use [7,8]. These findings are supported by adult studies showing that computer display position influences head and neck posture during computer use [9]. These temporary postural changes may extend to changes in habitual postures, though this issue has yet to be examined.

There has been little work linking specific cervical postures with neck pain in children. Hertzberg

[12] noted an association between neck pain and "postural deviations" but these were not specified. Adolescents have been reported to perceive posture as the major contributor to neck pain [13] but this may simply reflect lay beliefs. Although fixed sitting postures have been associated with neck pain in 11-14 year olds [14], no such association was found in a study of 8 year olds [15]. However, neck and shoulder pain has been associated with certain neck postures in adults [16,17,18] and there is minimal conflicting evidence [19,20]. It is believed that certain postures may invoke pain through higher neck muscle forces [21] or neck extensor muscle activity [22].

There have also been concerns raised that the increasing use of computers may put children at higher risk of neck/shoulder problems – such as those commonly seen in adult computer users [6,23]. Computer use may have a direct link to increased risk for neck/shoulder problems, or an indirect link via changes in habitual postures.

Niemi et al. [24] observed that activities involving static loading of the upper extremities, such as computer use, were associated with neck pain in children, and Ramos et al. [25] demonstrated a positive link between neck pain and the amount of computer use at school. Moreover, Hakala et al. [26] argued that the increase in adolescent neck prevalence rates between 1991 and 2001 was due to the increased use of computers. However, Van Gent et al. [27] and Burke and Peper [28] found no association between computer use and neck pain in children, and so further work is required in this area.

Neck pain is surprisingly common in adolescents, with a lifetime prevalence of around 13% at 13 years of age [29]. Annual prevalences around 18% [24,30] and month prevalences ranging from 8.8% [31] to 53% [18] have been reported for 10 to 18 year olds. No data on point prevalences of adolescent neck/shoulder pain have been reported. In general, the prevalence in adolescence approaches reported adult values (for example annual adult prevalences range from 16% [32] to 34% [33].

The aim of this study was to determine whether the computer exposure of 14 year olds was related to poorer usual sitting head and neck postures and to reports of neck/shoulder pain.

2. Method

2.1. Design

The study was a cross sectional survey involving questionnaires on computer use and neck/shoulder pain and photographic assessment of usual sitting posture.

2.2. Participants

884 adolescents with a mean (sd) age of 14.01 (0.24) years were included in the study. The adolescents were part of a longitudinal cohort (the Raine Study) of 2,000 children, followed since 18 weeks gestation. 476 (53.8%) of the participants were male. This cohort is described in detail by Newnham et al. (1993). The mean height was 1.64 (0.08)m and mean weight was 56.95 (12.41)kg.

2.3. Variables

Exposure to computers was measured in a questionnaire completed by each participant using the following question: *On average, how many hours a week do you usually use a computer, e.g. play video or computer games, use the Internet or chat on line (including school days and weekends)?* Possible answers were: "none at all", "up to 7 hours a week", "7-14 hours per week", "14-21 hours per week", or "21 or more hours per week".

The questionnaire also gathered information on the prevalence and nature of neck/shoulder pain using yes/no responses to the following questions:

1. *Have you ever had neck and shoulder pain?*
2. *Is your neck and shoulder painful today?*
3. *Has your neck and shoulder been painful in the last month?*
4. *Did your neck and shoulder pain last for more than 3 months?*

Possible answers were "yes" or "no" for question 1 and "yes", "no" and "never had back/neck pain" for the other questions.

Usual sitting posture was assessed by placing retro-reflective markers on the right outer canthus, right external auditory meatus (EAM), C7 spinous process, right acromion process, T12 spinous process. Lateral photographs were taken with each child sitting on a stool (adjusted to their popliteal height) and looking straight ahead and looking down at their lap. Marker points were digitised using PEAK motion analysis system and head/neck/thorax angles calculated. Angles are defined in Table 1.

Table 1
Definitions of Postural Angles

Name	Angle definition
Head flexion	Line of canthus to EAM with vertical (measured from vertical above intersect)
Neck flexion	Line of EAM to C7 with vertical (measured from vertical above intersect)
Craniocervical angle	Line of canthus to EAM with line of EAM to C7 (measured anterior to intersect)
Cervicothoracic angle	Line of EAM to C7 with line of C7 to T12 (measured anterior to intersect)
Thoracic flexion	Line of C7 to T12 with vertical (measured from vertical above intersect)

2.4. Analyses

SPSSv13 was used to calculate descriptive statistics and examine relationships using spearman, chi-square, logistic regression and unpaired t tests.

2.5. Ethics

The study was approved by the ethics committees of Curtin University of Technology and Princess Margaret Hospital for Children.

3. Results

3.1. Computer use

Thirty-eight percent of adolescents reported using a computer for more than 7 hours/week (~>1 hour/day on average), with 4.5 % reporting more than 21 hours/week (~>3 hours/day) (See Fig. 1).

3.2. Posture

When adolescents were sitting looking straight ahead they had a mean (sd) head flexion of 71.9° (9.3) , neck flexion of 51.9° (8.6), cranio-cervical angle of 160.1° (11.7), cervico-thoracic angle of 149.7° (8.0) and thoracic flexion of 22.1 (10.9). When adolescents were looking down at their hands in their lap they had a head flexion of 106.4° (13.0) , neck flexion of 68.9° (10.9), cranio-cervical angle of 142.6° (11.3), cervico-

Figure 1 Weekly use of computers.

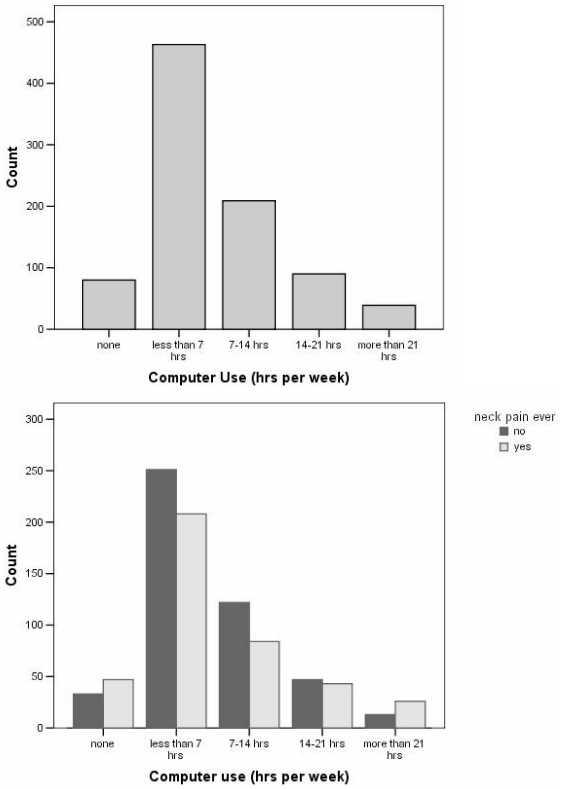

Fig. 2: Association of neck pain ever with weekly use of computers

thoracic angle of 134.8° (9.2) and thoracic flexion of 24.2 (11.3).

3.3. Neck pain

Nearly half (46.7%) of these adolescents reported ever having neck/shoulder pain; 28.0% reported pain in the last month, 4.7 reported pain today and 7.7% reported chronic neck/shoulder pain (lasted >3 months). Only around 1% of the adolescents had missing data for these variables.

3.4. Computer use – Pain Relationship

Computer use was related to reports of ever having neck/shoulder pain (Chi square = 12.6, p = .002) as shown in Figure 2. Adolescents who did not use a computer had significantly increased probability of developing neck pain as compared to those subjects who used a computer for 1-21 hours/week (p = 0.015, (Odds Ratio) = 1.79, 95%CI: 1.12-2.85). Similarly,

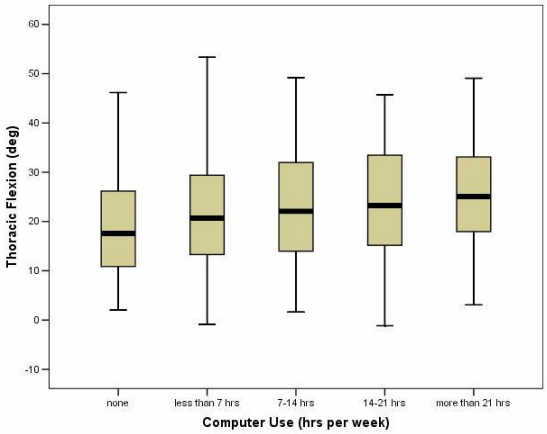

Fig. 3: Association of thoracic flexion with weekly use of computers

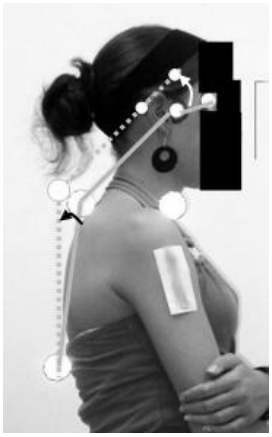

Fig. 4: Exaggerated illustration of the reduced head flexion and thoracic flexion postures of adolescents with pain (dotted line) compared with adolescents with no pain (solid line)

adolescents who used a computer more than 21 hours/week had significantly increased probability of developing neck pain as compared to those who used a computer for 1-21 days per week (p = 0.008, Exp(β) (Odds Ratio) = 2.51, 95%CI: 1.27-4.96).

3.5. Computer use – Posture Relationship

Computer use was also related to greater head flexion (rho=0.069, p=.043), neck flexion (rho=0.067, p=.049), cervico-thoracic angle (rho=0.102, p=.003) and thoracic flexion (rho=0.129, p<.001), though not to cranio-cervical angle (rho=-0.003, p=0.926). Figure 3 illustrates the increased thoracic flexion with increasing use of computers.

3.6. Posture – Pain Relationship

Adolescents who had ever had neck/shoulder pain had less head flexion (pain 71.0° (8.8), no pain 72.5° (9.6), $t_{df}=2.38_{862}$, p=0.018), a more acute cervicothoracic angle (pain 148.8° (7.8), no pain 150.4° (8.1), $t_{df}=2.98_{859}$, p=0.003) and less thoracic flexion (pain 21.3° (10.8), no pain 22.7° (10.9), $t_{df}=1.92_{859}$, p=0.055) than those with no experience of neck/shoulder pain (see Figure 4).

4. Discussion

Most (90.8%) of the 14 year olds in this study reported that they used a computer. This is lower than ABS figures [2] based on 11-14 year olds, probably due to our data being based on average weekly usage, rather than having used a computer in the last year.

A large proportion of the adolescents reported considerable weekly exposures to computers (>7 hours/week), in line with international estimates [3,4].

Computer use is clearly a significant activity for adolescents in affluent countries and thus its impact on health and development needs to be understood.

One in twenty adolescents had neck/shoulder pain on the day of assessment, and nearly half had experienced this pain at some time. The high prevalence of neck/shoulder pain in young people is poorly recognised by the community and also warrants close inspection. Early experiences of neck/shoulder pain are linked to adult pain experience [34] and thus initiatives to understand and prevent episodes in adolescents are important to reducing the population burden of neck/shoulder pain.

This is the first study to investigate the links between habitual neck posture and the amount of computer use in adolescents. Previous research has established that computer use has been shown to influence instantaneous working posture in both children [7] and adults [9,10,11]. The positive relationship between weekly computer use and increased flexion in usual sitting postures suggests that the postures assumed whilst using computers may promote the development of more flexed spinal postures. During adolescence, growth in spinal structures is especially rapid [35] and thus exposure to flexed static postures may be of increased significance during adolescence. Adolescence is also a time associated with other factors which may cause postural changes including: increased studying from paper sources, psychosocial issues associated with sexual maturity and participation in competitive sports. It has

been suggested that neck flexion may not be as damaging as extension [9] but findings in adults suggest that increased neck flexion [16,18,36] or forward head posture [36] are related to neck pain.

Our findings are consistent with Ramos et al. [25] who also found a significant relationship between computer use and neck/shoulder pain in adolescents. However these findings are in contrast to Van Gent et al. [27] and Burke and Peper [28] who did not find a relationship. The conflicting results may be due to differences in definitions of pain and measurement of computer use. For example, Burke and Peper [28] only measured computer use on Saturdays, and neck pain that was perceived by the subject as being due to computer use, thus possibly missing out on other occurrences of neck pain that might have related to computer use despite the contrary perception.

Interestingly the relationship between neck pain and computer use in this study was not linear but U shaped, with higher risk for very low and very high use groups. The mechanism for pain development in high computer use groups may be the prolonged durations of poor postures with limited postural variation. Equally, since the direction of any causality is ambiguous, neck pain may predispose to higher use through substitution of computer use for pain-provoking activities. The mechanism for pain development in the non-user group is less clear, but the lack of a home computer could relate to relative deprivation, which is a risk factor for neck pain in adults [37]. It is equally possible that the non-users could include adolescents who do not use computers because of their pain now or in the past. Further investigation of this group is required to evaluate the potential impact of differences in sex, physical characteristics other than posture, usual physical sedentary and vigorous activities, individual psychological characteristics and social factors which may mediate pain development.

Although it is clear from this study that factors such as computer use and head neck posture may contribute to the etiology of neck/shoulder pain in adolescents, this problem is likely to be multi-factorial and large prospective cohort studies investigating risk factors across a range of physical, lifestyle and psychosocial domains will be important in identifying clusters of risk factors.

5. Conclusion

Computer use was common for these adolescents and the lifetime prevalence of neck/shoulder pain was high. Computer use was related to their experience of neck/shoulder pain and to their usual sitting posture.

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