Musculoskeletal complaints by middle school students with computers use

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Abstract

Our children are the first generation growing up with computers and information technology surrounding them. They used it in all aspects of their life, including school, leisure, and as a means to communicate. Healthy interactive media strategies may be vital to preventing/reducing the incidence of discomfort similar to those of adults during computer use. This research paper will describe a study which has collected health and comfort data on the incidence and prevalence of computer-related musculoskeletal complaints and computer workstation designs in school and home among students in three middle schools in Massachusetts and New Hampshire, USA. General base line data from this three-year study, where students were tracked for any reports of musculoskeletal complaints as they progress from 6th through 8th grade will be reported.

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Keywords: Adolescents, discomfort, rest break

1. Introduction

The development of computer technology in the United States has allowed greater ease of data organization in the workplace as well as increased the availability of research through databases and search engines. Not only have adults increased their computer use over the years, but children are also spending more time e-mailing, playing video games, and word processing (Straker, Briggs, Greig, 2002). The Longitudinal Study of American Youth found that in 1990, only one in fifty children used a computer for ten hours or more outside of class for the entire year (Gillespie, 2002). In 2000, the Kaiser Family Foundation reported that nine percent of all children use a computer for more than an hour a day (Gillespie). Children are using computers more than ever, and there is a strong correlation between increased computer use, improper computer posture, and musculoskeletal pain, such as back, neck, and shoulder pain, in children ages 7-17 (Williams, 2002).

Childhood back, neck, and shoulder pain have been suggested to be a predictor of adult back, neck, and shoulder pain (Williams). Therefore, the risk factors associated with computer use causing these discomforts, need to be addressed at a young age in order to prevent musculoskeletal discomfort or injuries in adulthood (Williams).

In 1999, there were approximately 4.4 million computers in the classrooms throughout the United States, and about 98% of all schools owned a computer (Barrero, 2002). Currently, almost 30 million children in the United States have access to a computer at home,

and approximately 7.7 millions of these users are of middle school age (Williams & Jacobs, 2002). Researchers reported that the average daily use of computer users ages 8-18 was 101 minutes (Gillespie, 2002). The World Health Organization found that 30% of 11 year olds, 33% of 13 year old girls, 30% of 13 year old boys, 43% of 15 year old girls, and 33% of 15 year old boys in the United States report backache at least once a week (Williams, 2002). Another research study also reported that 23% of elementary school children complain of backache, and there is a lifetime prevalence of 36% of low back pain for children ages 11-17 years old (Barrero). Also, 56% of boys and 30% of girls were already suffering from degenerative changes of the spine (Barrero).

Epidemiological data on the relationship between computer use in children and the onset of musculoskeletal pain is difficult to find (Barrero, 2002). However, the literature has supported the idea that adult computer use may lead to a development of musculoskeletal injuries (William & Jacobs, 2002). In a study conducted by Cook et al. (as cited in Straker, 2001) 76% of adult computer users had experienced pain in their neck and upper extremity within the past 12 months (Straker, 2001). In a similar study by Evans and Patterson, it was reported that 67% of adults who used computers had experienced neck and upper extremity pain within the previous month (Straker, 2001). Studies conducted in elementary and middle schools have reported that children do experience musculoskeletal discomfort similar to those of adults during computer use (Williams, 2002). With the increase use among children, it is natural to think that computer use may lead to musculoskeletal pain in a younger population. Straker (2001) reported that children are using laptops for a larger portion of the day and week, with a mean of 3.2 hours a day and 16.9 hours a week. The study reported that 60% of students reported discomfort associated with the use of a computer (Straker, 2001). There was a correlation between the duration of computer use and the amount of discomfort. The most common complaint of discomfort was in the neck and shoulders. Studies by Jacobs & Baker, Harris et al (2005) and Williams (2002) have reported that the discomfort associated with computer use may be the result of inadequate workstation set-ups that do not meet students' postural needs. Some researchers (Oates, Evens & Hedge, 1998) suggested that children are at an even greater risk than adults because computers and peripherals are designed for adults' larger proportions.

2. Methods

This was a three-year descriptive longitudinal study, involving yearly administration of questionnaires, computer workstation analyses, and education on healthy computing to students starting in 6th or 7th grade through the completion of 8th grade.

There were three aspects to this study. At the beginning of computer technology classes in the 6th or 7th grades, the researcher sent home a letter and consent form to parents describing the study. Once the signed consent forms were received, the student was given an assent form to sign. The first phase of data collection began with the participant completing a survey asking about his or her use of interactive media at home and school and if he or she has any aches and pains with the use of interactive media. The second phase of data collection was the analysis of the student's home computer workstation. The third phase aspect of the study involved 20-30 minutes of interactive educational instruction provided by the researcher on how to use a computer correctly. Included in this instruction were computer workstation guidelines and stretch break recommendations. The education was provided during the computer technology class to all students in the class.

At the beginning of each consecutive school year, until the completion of 8th grade, the three aspects of the study were repeated in the computer technology classes.

Participants in school two were assigned to the intervention group. These participants were provided with mousepads that included 12 tips for an ergonomic workstation and were instructed to follow these tips when using the computer. Some tips included: monitor and keyboard centered in front of you; wrists flat and straight; take frequent short breaks; and feet flat on floor or on footrest.

2.1 Participants

The researcher recruited all 6th grade students (male and female) enrolled in computer technology classes at

two middle schools in Massachusetts and all 7th grade students enrolled in computer technology classes at one junior high school in New Hampshire. In year one, there were 376 students participating in the study. 80% of the students were between 12 and 13 years with an age range of 12-15 years; 52% were female and 41% were male of the 353 students who responded to this question. Approximately 66% of the participants were Caucasian.

In year two, there were 243 students and 152 participants in year three. The high attrition was due to students graduating from one of the schools in grade 7. There were no significant differences between the students who completed the study and those who graduated and completed the study.

2.2 Measures

The survey used in the study to determine the prevalence of computer-related musculoskeletal discomfort/pain was adapted from one used by Katz, Amick, Carroll, Hollis, Fossel, & Coley (2000) in their research on the prevalence of upper extremity musculoskeletal disorders in college students. A "yes" response to the question, "Have you ever experienced pain/discomfort in your hands, wrists, arms, shoulders or neck, during or after working on a computer?" was used to indicate the prevalence of musculoskeletal discomfort/pain.

The computer workstation assessment used in this study to evaluate the student's home computer is a public domain document that was developed by the US Army Ergonomics Working Group. The assessment requires a "yes" or "no" response to questions about the computer workstation set-up and was completed independently by the participant in approximately 10-15 minutes.

3. Results

3.1. Descriptive data

Data was analyzed using descriptive statistics of frequencies, Pearson's Correlations, and Chi-Squares to examine any trends evident between the groups and surveys. The Friedman's Rank Test was used to analyze specific questions within the repeated surveys over the three-year period. All statistical tests were examined for significance using a $p < 0.5$ significance level. Data was analyzed individually between the three schools and together as a treatment group verses the control group.

3.1.1. Musculoskeletal discomfort/pain

There was a significant steady decrease overall in the report of musculoskeletal pain. In year one, there were no significant differences between the intervention (school two) and control groups (school one and three) in the amount of reported pain. However, a significant difference was found when analyzed individually for each school using the Chi-Square. School one had significant more report of pain at baseline. 65% of the 61 students who responded to this question reported having pain. Compared to the 43% of 162 students from school two and 31% of school three of 129 students.

Year One

In year one of the study, overall 41% of the 352 participants who responded to this question reported having experienced computer-related musculoskeletal discomfort/pain after working on a computer. Of those students reporting discomfort/pain, 15% of the 139 participants who responded to this question reported first noticing it within the past year.

Year Two

In year two of the study, overall 18% of the 235 participants who responded to this question reported having experienced computer-related musculoskeletal discomfort/pain after working on a computer. Of those students reporting discomfort/pain, 3.2% of the 40 participants who responded to this question reported first noticing it within the past year.

Year Three

In year three of the study, overall 8% of the 146 participants who responded to this question reported having experienced computer-related musculoskeletal discomfort/pain after working on a computer. Of those students reporting discomfort/pain, 0.8 % of the 17 participants who responded to this question reported first noticing it within the past year.

3.1.2. Computer Use

Friedman rank test showed a significant increase in the amount of computers that the students/families owned over the three years ($p=.045$). In year one, students owned on average 2.5 computers; year two-

owned 3.0 computers; and year three, owned 3.5 computers.

Students over all three years reported doing most of their computing at a desk, though the location of the desk changed. In year one, the majority of students reported working in their family room. The majority of students in year two did most of in their own room or the family room. And in year three most of the students responded that they did most of their computing in their own room.

3.1.2.1 Amount of time on the computer

Year one

Table 1 shows the amount of time that participants reported they spent on the computer. It is notable that 90% of the students reported spending 0-6 hours/day using a computer, with 10% reporting 4-6 hours/day of usage and 3% reporting using the computer more than 8 hours/day. There was not a significant difference between the individual schools; these results were similar to the overall findings.

Year Two

It is notable that 56% of the students reported spending 0-6 hours/day using a computer, with 9% reporting 4-6 hours/day of usage and 6% reporting using the computer more than 8 hours/day.

There was a significant difference found using Chi-Squares between the treatment group (school two) and control group (school one and three) (p=.000). 75% of students in the control group reported using their computer for 6 or more hours/day contrasted to 25% of the treatment group. 62% of the treatment group reported using the computer 0-6 hours/day compared to 38% to the control group. There was a significant difference found using Chi-Squares between the three schools (p=.000). In School two, 94% reported using the computer 0-6 hours/day compared to 73% and 79% at the other schools. 27% in school one reported using the computer more 6 or more hours/day compared to 6% in school two and 21% in school three.

Year Three

There was a significant increase in computer use over the three years (p=.016). In year three, 80% of the students reported using the computer for 0-6 hours/day, 5% used it for 6-8 hours and 5% used it 8+ hours/day.

Across all three years students used a desktop computer about 85% of the time. Student's use of notebook computers increased from 11% in year one to 18% in year three. However, differences of usage between computer types over the three years were not found to be significant.

3.1.2.2 Computer workstation arrangement

Year One

There were many significant negative correlations between students reporting pain and the arrangement of their computer workstation. Using Pearson Correlations, it was found that as pain decreased, there was an increased reporting that the seat was positioned so that the student's feet were flat on the floor (p=.028). As reported pain decreased, there was an increased reporting that the seat adjusted to 14-21" (p=.040), and the seat pan was at least 18.25" (p=.000). However as pain increased, there was a decrease in reporting that the student used headsets for the phone (p=.042).

Year Two

Computer workstations were not survey this year.

Year Three

There were many significant negative correlations between students reporting pain and the arrangement of their computer workstation in year three of the study. As pain decreased, there was an increase in reporting that the chair backrest contoured to the student's back (p=.004), that they took more rest breaks (p=.025), and that the computer monitor was free from glare (p=.041).

3.2. Associations

Year One

The relationship between the existence of computer-related musculoskeletal discomfort/pain and time spent using a computer was made based on student's report of computer use in a "typical" day (0-2 hours/day, 2-4 hours/day, 4-6 hours/day, 6-8 hours/day or 8+ hours/day). In year one, Chi-Square analysis indicated that the relationship between the frequency of symptoms and the reported number of hours per day of computer use was not significant (p=1.00). However, the relationship between the reports of pain and the frequency of breaks taken, was significant (p=.004). There were also no significant differences between the three schools.

Year Two and Three
Chi-Square analysis showed no significant relationships between time spent on the computer and reported musculoskeletal pain for year two or year three (p-values were between .600 to 1.00). This may be due to the decrease in overall reported musculoskeletal pain.

3.2.1 Rest Breaks
Using the Friedman Rank test, there was significant difference between the three years overall for the use of rest breaks due to pain (p=013).

Year One
In year one, the significant relationship between the existence of computer-related musculoskeletal discomfort/pain and breaks taken from computer use was made based on the student's report of how often the student takes a break from working on the computer (never, only after 2 hours work, once every 1-2 hours, at least once an hour and more than once an hour). Of those participants reporting computer-related musculoskeletal discomfort/pain, 41% of these 350 individuals who responded to this question reported taking a break at least once an hour, and 26% reported taking a break more than once an hour (p=.004).

Year Two and Year Three
There were no significant relationships found within and between the schools for year two and year three.

3.2.2 Difficulty Performing Various Functional Activities
Overall, as the amount of reported pain decreased over the three years, difficulty performing functional activities also significantly decreased in typing on the computer, handwriting assignments, taking class notes and carry books.

Year One
In year one, student who reported computer-related musculoskeletal discomfort/pain also reported significantly more difficulty performing many functional activities, such as carrying books, taking notes and playing video games then their peers who did not report pain.

Year Two and Year Three
Similar trends were found in year two and three as were seen in year one. However the largest number of difficulty areas due to musculoskeletal discomfort/pain was seen in year one.

4. Discussion

This study confirms Jacobs and Baker's (2002) research that musculoskeletal discomfort/pain associated with computer use in adults may be prevalent throughout middle school aged students. In year one of this study, 41% of the participants reported that they have experienced computer-related musculoskeletal discomfort/pain. Of those students reporting discomfort/pain 15% reported first noticing it within the past year. This is a large percentage of children experiencing pain and having difficulty with other activities, thus impacting their quality of life. This pain and difficulty may also lead to other psychosocial and physical health problems. By year three, the report of pain had significantly decreased and significantly fewer students were reporting pain that started within the last year. There were also significant correlations between proper ergonomic chair settings and less reported pain. This strongly suggests that the intervention provided, helped decrease the report of pain.

Despite 56% of the students reporting spending 0-6 hours/day using a computer in year two, the amount of time spent using the computer was not associated with musculoskeletal discomfort/pain.
In year two, it is interesting that the control group used more computer time than the intervention group. This may be due to differences between the school curriculums, requirements and computer availability.

Harris, Straker, Pollock, & Trinidad (2005) and HermanMiller (2004) both discuss that children now are the first generation growing up with computers and information technology and used it in all aspects of their life, including school, leisure, and as a means to communicate. This is becoming true for adults as well, however computer stations are more properly sized for adult proportions and the employers devote more resources and time to arrange healthy ergonomic work stations for their employees (Hermanmiller). Hermanmiller describes that schools are getting increasing amounts of money for computers to be put into the classrooms but that money does not include costs for ergonomic training or workstation set-up for staff or students. Thus the computers are being used

improperly and setting the stage to develop MSD (Hermanmiller). Harris, Straker, Pollock, & Trinidad (2005) reported a decrease in physical weekend activity and increase in computer use. Harris and Straker (as cited in Harris, Straker, Pollock & Trinidad, 2005) report finding that children continue doing a task with technology even if they are experiencing discomfort due to that use.

It has been reported that proper work station arrangements and taking stretch breaks decrease the occurrence of MSD. In this study, the implementations of ergonomic breaks and increase awareness of proper positioning may have assisted in the decrease of reported pain over the three years.

Application/generalizability

This population is too small to generalize to the greater population. However, these results do alert us to a trend of musculoskeletal discomfort with computer use among school age children.

Limitations

As in any study, there are limitations and for this study, one major limitation is the use of self-report survey. School one started with a significantly higher percentage of students reporting pain than school two or three. This may have affect the results, however there was a steady decrease in reported pain overall, thus it seems that the initial higher rate did not effect the results.

5. Conclusion

A great deal of further research is necessary to understand how computers are influencing the health of America's children. This study is just a preliminary examination of many questions about children and computer use. Without controls in this area, we may be raising children who are more prone to musculoskeletal disorders because they have had a longer exposure period to computer use and also, have no idea how to protect themselves through the use of ergonomically correct computer workstations (Jacobs & Baker, 2002). There are determinants that can be modified to help decrease the prevalence of computer-related musculoskeletal neck, back, and shoulder pain in children. Healthy interactive media strategies may be vital to preventing/reducing the incidence of discomfort similar to those of adults during computer use.

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