Computer-related posture and musculoskeletal discomfort in schoolchildren

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Abstract

The aim of the study was to investigate the posture and musculoskeletal discomfort of secondary school students while working at computers in school. Students (n = 40) were observed while working at a computer during their designated computer class. The Rapid Upper Limb Assessment Tool (RULA) was used to assess posture. A Body Discomfort Chart (BDC) and Visual Analogue Scale (VAS) were used to record the area(s) and intensity of musculoskeletal discomfort, if any, experienced by the students at the beginning and end of the computer class. None of the students' posture was in the acceptable range (Action Level 1) according to RULA. The majority (65%) were in Action Level 2, 38% were in Action Level 3, and 5% were in Action Level 4. Poor working postures were associated with reported discomfort in the spine and shoulder areas. Secondary schoolchildren demonstrated poor working posture and had musculoskeletal discomfort during computer use. RULA proved to be, in general, a suitable method for the evaluation of students' posture. RULA scores corresponded well with reported discomfort, indicating that poor posture in a particular area is associated with discomfort in that area.

Keywords: Children, computer, posture, musculoskeletal discomfort

1. Introduction

The Irish Government launched the Schools I.T. 2000 strategy in 1997 [1]. The aim of this initiative was to ensure that there were at least 60,000 multimedia computers in Irish schools by 2001. The National Centre for Technology in Education (NCTE) was formed at this time to implement this strategy. In 2004, a new initiative was launched to bring Broadband Internet access to every school in the Republic of Ireland by the end of 2005. These initiatives have resulted in an increase in the number of classes that involve computing. This, coupled with the widespread increase in popularity of home computers arouses a legitimate concern about the health of children and adolescents as they spend more and more time operating these devices [2].

1.1. Posture at the computer

Developing a causal relationship between risk factor and disorder development associated with computer use has been difficult [3]. Two of the most common potential risk factors investigated in the literature thus far, have been posture [4] and workstation design [5,6]. Oates et al [4] investigated computer use by elementary schoolchildren using the Rapid Upper Limb Assessment (RULA) and found that many children were placed in an "at risk of injury" posture. Laeser et al [5] also used RULA in their investigation of the effects of computer workstation design on posture and concluded that

childrens' posture improved significantly at an adjusted workstation. This finding is similar to that of Straker et al [6] who reported that individually adjusted workstations had effects on posture.

1.2. Computer-related musculoskeletal disorders

There is limited research that investigates the relationship between computer use and musculoskeletal discomfort in children. The prevalence of MSDs in adults related to computer use has been reported to be as high as 76% [7]. There is moderate evidence to suggest that children are likely to experience similar prevalence and severity rates as adult computer users [3]. Some researchers suggest children may be at greater risk than adults because of the early age at which many children begin to use computers [8] and because computers and computer furniture are not the correct size for children, as they are designed for adults [4]. Jacobs and Baker [9] investigated the association between children's computer use and musculoskeletal discomfort and found that almost half of the 6th grade students in the study had experienced some musculoskeletal discomfort in at least one body part, with the most common areas of moderate to severe discomfort being the neck, back and shoulders.

1.3. Aims of the study

There is growing concern about the effect of computer use on the musculoskeletal health of children and adolescents. There is a dearth of research to determine the risks associated with computer use or if poor posture actually leads to musculoskeletal discomfort in the young. It was the aim of this study therefore to investigate computer-related posture and discomfort in secondary school children.

The specific objectives of the study were:

- To assess the posture of secondary school children during computer use
- To investigate the incidence of musculoskeletal discomfort related to computer use in secondary school children.
- To investigate the relationship between posture and musculoskeletal discomfort.

2. Method

2.1. Study design

An experimental design using observational (Rapid Upper Limb Assessment) and subjective (Body Discomfort Chart; Visual Analogue Scale) methods was conducted.

2.2. Participants

Participants were from a population of students attending secondary schools in one county of the Republic of Ireland. Normal, healthy Transition Year students who participated in computer classes during timetabled school hours were suitable for inclusion in the study. Students were excluded if they had previously diagnosed postural anomalies or recent back or neck injuries.

2.3. Ethical Approval

The Research Ethics Committee of the Faculty of Health Sciences in Trinity College, Dublin granted ethical approval.

2.4. Materials

2.4.1. Rapid Upper Limb Assessment (RULA)

RULA [10] was used to assess the posture of students working at a computer. RULA focuses on the upper body and is designed to assess a person working at a VDU.

2.4.2. Questionnaire

A short questionnaire that sought information on the participant's age, diagnosis of any postural deformity, or history of recent back or neck injuries was developed.

2.4.3. Body discomfort chart & visual analogue scale

A modified Body Discomfort Chart [11] was used. The student marked the area(s) of pain/discomfort on this chart.

A set of modified Visual Analogue Scales [12] accompanied the modified Body Discomfort Chart (BDC). Students indicated the level of discomfort in each area indicated on the BDC on separate Visual Analogue Scales (VAS).

2.5. Procedure

A list of all secondary schools in one county in the Republic of Ireland was obtained from the Department of Education and Science website [13]. Each school was telephoned to ascertain their eligibility for inclusion in the project. A school was considered eligible if they had a Transition Year Programme in the school that included computer classes.

A letter was sent to the Principal of each eligible school with details of the research proposal. The principal was asked to respond by post (SAE provided), telephone, or email if interested in participating. A follow-up telephone call was made to any school that failed to respond within two weeks. Parental and student information and consent forms were then posted to the schools for distribution by the Principal. Each school was contacted to arrange the school visits. Each school was visited on four occasions. The first two were used for the collection of consent forms, and to allow the students to become accustomed to the researcher's presence in the computer room. The second two sessions were used for data collection.

A modified BDC and a set of modified VAS were distributed at the beginning and end of the class. The students were instructed to mark on the BDC any areas of discomfort or pain and to rate the severity of the pain/discomfort in each specified area on separate VAS. The posture of each student at a computer was observed and assessed. RULA recording started approximately ten minutes after the class began to allow the students to settle. Each student was observed for a 10-minute period of time during the class. The most usual posture of the student during these 10 minutes was noted and was scored using RULA. The results of the BDC and VAS were calculated and analysed.

3. Results

3.1. Sample

Of the 26 secondary schools in the sample, 13 were eligible for inclusion in the study. Of these 13 schools, 5 were willing to participate, 3 were unwilling and 5 did not respond. One school that was willing could not participate, as their computer module was not running at the same time as the study. Therefore four schools remained for inclusion in the study. Ten students 9randomly chosen from those with consent) from each school participated. That is 40 students (mean age 15.4 years), consisting of 16 male and 24 female took part.

3.2. Rapid Upper Limb Assessment (RULA)

Five percent of students were found to be in Action Level 4 (n=2) of RULA, 30% were in Action Level 3 (n=12) and 65% of students were in Action Level 2 (n=26). No student was found to be in Action Level 1 (Fig. 1).

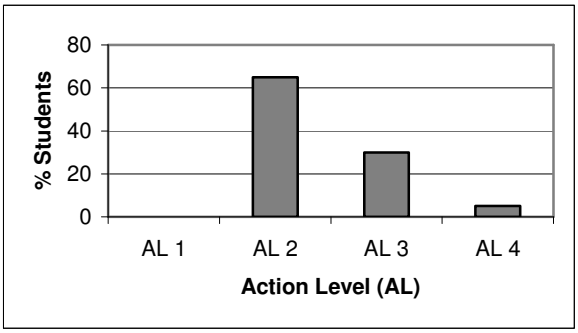

Figure 1. Percentage students in each Action Level

3.3. Body discomfort chart & visual analogue scale

Forty-five percent of students reported musculoskeletal discomfort at the beginning of the computer class. Eighty percent of students reported musculoskeletal discomfort at the end of the computer class (Fig. 2). The most common areas for reported musculoskeletal discomfort at the beginning of the class were thoracic spine (38.9%), cervical spine (22.2%) and lumbar spine (22.2%). The mean discomfort level was 2.6/10. The standard deviation was 1.04. The most common areas for reported discomfort at the end of the class were the cervical spine (50%), lumbar spine (34.4%), thoracic spine (21.9%) and right and left shoulders (18.8% each). The average level of discomfort reported was 3/10. The standard deviation was 1.94.

Figure 2. Percentage reported discomfort

The mean discomfort score reported by students in Action Level 4 was 3.2, in Action Level 3 was 3.4 and in Action Level 2 was 2.6. Students in Action Level 3 were 1.6 times more likely to report new areas of discomfort at the end of the class than those in Action Level 2. Students in Action Level 4 were 1.1 times more likely to report new areas of discomfort than those in Action Level 2 (Fig. 3).

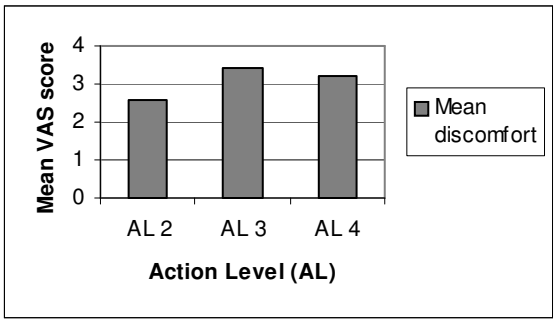

Figure 3. Mean discomfort related to Action Level

All students in Action Level 4, 83% of those in Action Level 3 and 65% of students in Action Level 2 reported back (thoracic and lumbar spine) or neck (cervical spine) discomfort at the end of the class (Fig. 4). With regard to shoulder discomfort, 50% of students in Action Level 4, 25% in Action Level 3 and 12% in Action Level 2 reported discomfort at the end of the class (Fig. 5).

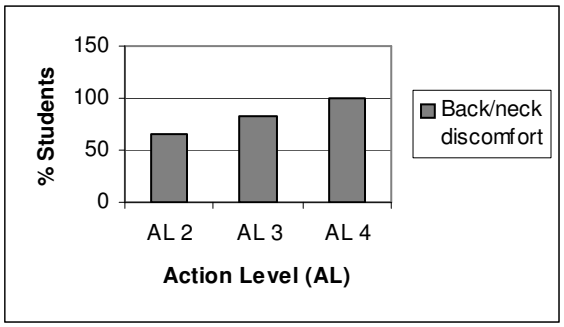

Figure 4. Back/Neck discomfort in each Action Level

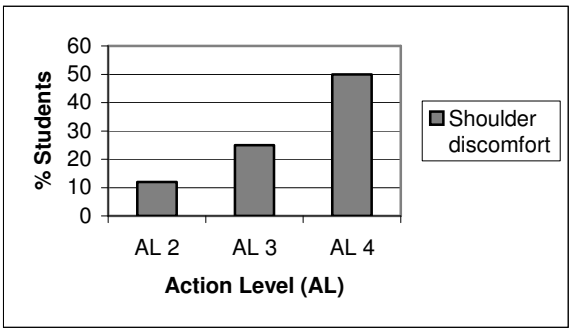

Figure 5. Shoulder discomfort in each Action Level

4. Discussion

The aim of this study was to investigate the posture of students in secondary school during computer use and to determine whether the posture adopted was related to reported musculoskeletal discomfort. The lack of literature in this area means that there is limited scope for direct comparison with other studies.

Forty students in 4 secondary schools participated in the study. Students were observed during their normal computer class times ensuring high external validity. One researcher carried out all the RULA observations.

4.1. Posture

No student was found to have acceptable posture, that is, posture in Action Level 1. The majority were in Action Level 2, indicating that further investigation is needed and changes to the working environment or work practices may be required. Thirty percent were in Action Level 3, indicating

that further investigation and changes are required soon. Just 5% of students were in Action Level 4. Investigation and changes are required immediately for these students. Similar results were found by Oates et al [4] where none of the 95 schoolchildren in their study were deemed to have acceptable posture (Action Level 1). Research which used RULA to assess the posture of adults during computer use, similarly found no subject to have acceptable posture [14].

The findings of this and other existing studies in the subject area raise an interesting issue. The fact that no subject in any of the reviewed studies was in Action Level 1 is a matter of concern. This implies that none of the subjects worked at the computer in an acceptable posture. An alternative explanation may be that the RULA marking system places too strict a limit on what is considered "acceptable" posture.

4.2. Discomfort

Forty-five percent of students reported discomfort at the beginning of the computer class and 80% reported discomfort at the end of the computer class (Fig. 2). The mean level of discomfort increased from 2.6 at the beginning of the class to 3 at the end. This increase in reported frequency and intensity of discomfort might have been caused by the use of computers during the class. This suggestion is supported by the work of Jacobs and Baker [9] who found that between 22.7% and 54.5% of students felt that using a computer worsened their pain. It is interesting and quite worrying to find such high levels of baseline reported discomfort. The high level of reported discomfort at the end of the computer class is also quite worrying as research indicates that when children experience discomfort while using a computer, they are more likely to continue and less likely to report it to adults than children playing sports or musical instruments [15].

The most common areas for discomfort at the beginning of the computer class were the low back, neck, shoulders and knees. The most common areas for reported discomfort at the end of the computer class were the low back, neck, shoulders and thoracic spine. The distribution of discomfort is similar to that reported by Jacobs and Baker [9]. The average discomfort score for those in Action Level 3 was higher than those in Action Level 2 but a slight decrease in average discomfort score was seen from Action Level 3 to Action Level 4 (Fig.3). This may be explained by the relatively small number of students in Action Level 4 (n=2) compared to Action Level 3 (n=12) and Action Level 2 (n=26). A similar study with a larger number of students is recommended. A relationship was noted between increasing Action Level and increased frequency of reported discomfort in the back/neck and shoulder areas (Fig.4 & Fig. 5). The results demonstrate that poor posture is associated with specific body part discomfort reported at the end of the computer session.

5. Conclusion

In this study, no student was found to have an acceptable posture while working at the computer. These findings are similar to previous research in this area [4]. The majority of postures were in Action Levels 2 and 3, indicating that further investigation and possible intervention is required.

A substantial proportion of students reported discomfort at the beginning of the computer class. Further investigation of baseline discomfort levels may be useful in determining if this finding is representative of schoolchildren in general and also, the cause of this discomfort. There was an increase in reported discomfort at the end of the computer class, which may have been caused by computer use. This finding is quite worrying, as these students will soon be entering a working environment where the vast majority will be expected to use computers daily.

RULA proved to be, in general, a suitable method for evaluating student's posture. A relationship was seen between increasing Action Level and increasing frequency of reported discomfort in the back/neck area and the shoulders. An increase in average discomfort score was seen from Action Level 2 to Action Level 3 but this relationship was not observed from Action Level 3 to Action Level 4. This finding is limited due to the small number in Action Level 4. Further investigation is required with a larger population.

Acknowledgements

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