Does training in workplace adjustment and posture prevent occupational overuse syndrome in workplace based computer users?

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Clinical Question

Does training in workplace adjustment and posture prevent Occupational Overuse Syndrome in workplace based computer users?

Clinical Scenario

Training in workstation adjustment and posture is often recommended to prevent occupational overuse/ repetitive strain injuries for computer users in the workplace. What is the effectiveness of this intervention in preventing these types of conditions?

Summary of Key Findings

- 14 studies were located that met the inclusion/exclusion criteria.
- 3 RCT studies were located and appraised.
- One RCT found improvements in postural stressors, appropriate workstation components and reported symptoms primarily in participants under the age of 40 years who underwent an ergonomic training program. However despite a rigorous study design, no between groups statistical analysis was conducted.
- One RCT found less short-term musculoskeletal discomfort as a result of two different types of ergonomic interventions but the differences were small between the intervention and control groups. No differences were found for reported long term strain levels or prevalence of pain.
- One RCT found positive changes in participant knowledge and work habits as a result of two different types of ergonomic training program. However the differences between the experimental groups and the control group were small and there were methodological problems with the study design.
- None of the studies measured changes in injury or incidence rates of occupational overuse syndrome (or related conditions) or effects on compensation claim numbers or costs.

Clinical Bottom Line

Providing training in workplace adjustment and posture may lead to small reductions in musculoskeletal discomfort and small increases in knowledge and appropriate workstation adjustments. None of the studies reviewed measured changes in injury or compensation claim rates related to occupational overuse syndrome. Currently there is no published evidence that training can prevent occupational overuse or related disorders amongst workplace based computer users.

Limitation of Summary of Evidence

This summary of evidence has been individually prepared and has not undergone a process of peer review.

Methodology

Search Strategy

Using the levels of evidence as defined by the NHMRC (2000), the search strategy aimed to locate the following study designs:

Level I	Systematic Reviews and Meta-analyses;
Level II	Randomised Controlled Trials;
Level III	Controlled trials, cohort or case-control analytic studies;
Level IV	Case series: Post – test only, Pre - test/Post – test;
Level V	Expert opinion including literature/narrative reviews, consensus statements, descriptive studies and individual case studies.

A search was also conducted for clinical practice guidelines based on these levels of evidence.

Search Terms

Patient/Client:	Occupational overuse syndrome, cumulative trauma disorders, repetitive strain injury, repetitive strain injur*, computer us*, video display unit, video display terminal
Intervention:	Training, education, ergonomic training, workplace adjustment, workplace ergonomics, workplace modification
Comparison:	Nil
Outcome:	Prevention

Sites/Resources Searched

- National Health and Medical Research Council
- New Zealand Guidelines Group
- National Guidelines Clearinghouse
- UK Guidelines: National Electronic Library for Health, Clinical Guidelines Database
- Scottish Intercollegiate Guidelines Network (SIGN)
- Workcover NSW
- National Occupational Health and Safety Commission
- Cochrane Library
- Database of Abstracts of Reviews of Effectiveness (DARE)
- PEDro – The Physiotherapy Evidence Database
- Effective Health Care Bulletins
- Centre for Clinical Effectiveness (Monash University) – Evidence Reports
- HTA Health Technology Assessments
- Joanna Briggs Institute
- PubMed
- Journals@Ovid Full text
- Medline – Pre Medline
- CINAHL
- AMED
- Embase
- OSH-ROM

Inclusion/Exclusion Criteria

Inclusion Criteria

- Studies including prevention related outcome. Eg. Incidence of OOS, injury rates, workers compensation claims; symptoms of OOS or related conditions, reduction in risk factors for OOS.
- Studies investigating training as an intervention to prevent occupational overuse injuries or related conditions amongst computer users
- Studies published in English

Exclusion Criteria

- Studies investigating treatments (as opposed to preventive training/educational interventions) for occupational overuse injuries or related conditions

Results

Results of Search

13 relevant studies were located and categorised as follows:

Table 1. Study designs of articles retrieved by search

Methodology of Studies Retrieved	Number Located	Source of Evidence
Clinical Practice Guidelines (Evidence Based)	0	N/A
Systematic Reviews or Meta – analyses	0	N/A
Randomised Controlled Trials	**3**	**PubMed**
Controlled trials, cohort or case-control analytic studies	1	Reference list of RCT article
Case series: Post – test only, Pre - test/Post - test	5	PubMed x1 Embase x1 Cochrane Controlled Trials register x1 Medline x1 CINAHL x1
Expert opinion including literature/narrative reviews, consensus statements, descriptive studies and individual case studies	5	PubMed x2 OSH – ROM x1 AMED x1 NOHSC Website x 1

Specific Results

The randomised controlled trials were the only studies critically appraised for this summary, as they represent higher levels of evidence. The studies and appraisal findings are summarised in Tables 2 and 3.

Table 2. Description and Appraisal of RCT by Brisson et al (1999)

Objective of Study
To evaluate the effectiveness of an ergonomic training program on the prevalence of postural stressors and appropriate features of workstations and the prevalence of musculoskeletal disorders among VDU users at a large university in Canada.

Intervention Investigated
Experimental group (N = 284) received 2 x 3 hour instructor led training sessions over a two-week period. Training consisted of lecture, demonstration, simulation and participant practice. Program targeted adjustment of workstation and preventative practices at work. Control group (N = 343) received no intervention.

Population
University sector workers using a VDU for more than 5 hours per week.

Primary Outcome Measures
1. Prevalence of workstations with appropriate components, measured via a 10-point checklist.
2. Prevalence of three postural stressors (twisted neck, height of visual target, bent hand-wrist line) associated with musculoskeletal disorders, measured via questions within the 10-point checklist.
3. Prevalence of musculoskeletal disorders, self reported symptoms measured via a self-administered questionnaire, physical signs and indicators measured via a physical examination.

Measures taken for both groups 2 weeks before and 6 months after the training intervention. Other variables such as the effect of age, number of hours of VDU use per week, seniority in current job and the combination of high demands and low latitude, leisure time physical activity, smoking, and body mass index were evaluated as potential modifiers of the effect of training musculoskeletal disorders.

Results
Prevalence of Appropriate Workstation Components
There was a modifying effect for age on the prevalence of appropriate workstation components. The prevalence of appropriate workstation components increased significantly for 8 out of the 10 items for the exp. group ($p<0.05$) and 3 out of the 10 items for the control group ($p<0.05$) for participants aged less than 40 years of age. The prevalence of appropriate workstation components increased significantly for 5 out of 10 items for the exp. group ($p<0.05$) and 1 out of 10 items for the control group ($p<0.05$) for participants aged 40 years or more.

Prevalence of Three Postural Stressors
There was a modifying effect for age on the prevalence of three postural stressors associated with musculoskeletal disorders. There were significant decreases in the prevalence of all three postural stressors for the exp. group ($p<0.01$) and a significant decrease in only one postural stressor (bent hand - wrist line) for the control group ($p<0.01$) for participants aged less than 40 years. There were significant decreases in the prevalence of two postural stressors (twisted neck and bent hand - wrist line) for the exp. group ($p<0.01$) and for the control group ($p<0.05$) for participants aged 40 years or more.

Prevalence of Musculoskeletal Disorders
There was a modifying effect for age on the prevalence of musculoskeletal disorders.

Self-administered questionnaire
- *Participants less than 40 years:* There was a 16 %* decrease in the prevalence of musculoskeletal disorders for the exp. group which was statistically significant ($p<0.01$, within groups analysis). There was an 8%* decrease for the control group but this was not statistically significant ($p=0.07$, within groups analysis).
- *Participants 40 years or more*: There was a 3%* increase in the prevalence of musculoskeletal disorders for the exp. group and a 1%* increase in the control group but neither of these results were statistically significant, ($p=0.09$ and $p=0.57$ respectively, within groups analysis).

Physical examination
- *Participants less than 40 years*: There was a 16%* decrease in the prevalence of musculoskeletal disorders for the exp. group which was statistically significant ($p=0.01$). There was an 8%* decrease for the control group but this was not statistically significant ($p=0.08$).
- *Participants 40 years or more*: There was a 4%* increase in the prevalence of musculoskeletal disorders for the exp. group and a 2 %* increase for the control group but these results were not statistically significant, ($p=0.05$ and $p =0.41$ respectively).

Authors Conclusions
Improvements in postural stressors and appropriate workstation components occurred more frequently in the experimental group. Improvements tended to be more frequent in participants under 40 years of age. Improvements in musculoskeletal disorders occurred in the experimental group for participants under the age of 40 only.

Reviewer Appraisal Comments

Validity (Methodology, rigour, selection, biases)

- Participants assigned to the experimental or control group on the basis of the units in which they worked.
- Work units randomised to either experimental or control group.
- No details provided of random allocation process.
- Participant eligibility criteria established and groups matched to ensure comparability of results.
- No information provided re blinding of researchers during allocation process.
- Blinding of assessor during the physical examination of participants.
- The physical examination began 3 months after the data collection had started, only 79% of participants underwent the physical examination.
- All participants treated the same way apart from the intervention under investigation.
- No power calculation provided, so cannot comment on adequacy of the sample size.

Results (Favourable or unfavourable, specific outcomes of interest, size of treatment effect, stat. and clinical significance)

- Statistical analysis provided for within group differences only. No between groups statistical analysis was conducted, so it is unknown if the differences in outcome measures between the two groups are statistically significant. Confidence intervals for the size of the treatment effect for each outcome measure cannot be estimated as no standard deviation data are provided.
- The definition of 'musculoskeletal disorders' used in this study is based on authors' own definition.
- The authors conclusion that there have been 'improvements' in musculoskeletal disorders in the experimental group for participants less than 40 years of age simply means a 'decrease' in self reported symptoms and physical signs as measured by an occupational therapist. The conclusion is not based on injury rates or claim numbers.
- No information on program costs provided.

Table 3. Description and Appraisal of RCT by Ketola et al (2002)

Objective of Study
To evaluate the effect of an intensive ergonomic approach and education on workstation changes and musculoskeletal disorders among workers who use video display units.

Population
Office based professionals with self-reported musculoskeletal symptoms, mouse use for more than 5% of the work time with the VDU, aged <61 years.

Intervention Investigated
- *Intensive Group (N = 39*): Worksite visit (1.5 – 2 hours) from a physiotherapist who introduced an ergonomic checklist, which emphasised the layout/environmental conditions, workstation adjustments and work breaks. Subjects then evaluated their workstation according to the checklist, findings discussed with the physiotherapist and adjustments and alterations made. Advice re work postures and pause breaks provided by the physiotherapist. All subjects provided with a one-page leaflet on musculoskeletal health in association with VDU work.
- *Ergonomic Education (N = 35):* Subjects attended a one-hour training session in ergonomics in groups of 2 – 6 people. Subjects instructed in principles of ergonomics in VDU work and given same checklist as the intensive group. Subjects were encouraged to evaluate their own workstation, implement changes and ask for equipment if necessary. Subjects were instructed to add short pauses to work and adopt relaxed work postures. All subjects provided with a one-page leaflet on musculoskeletal health in association with VDU work.
- *Reference Group (N = 35):* Provided with a one-page leaflet only on musculoskeletal health in association with VDU work.

Primary Outcome Measures
1. *Changes in Workstation Ergonomics*: Most common changes in the workstations observed or measured by two blinded experts. Measurements taken at baseline, 2 months and 10 months post intervention.
2. *Changes in Ratings of Workstation Ergonomics*: Measured as an overall ergonomic rating on a scale from 4 (poor) to 10 (excellent). Measurements taken at baseline, 2 months and 10 months post intervention.
3. *Musculoskeletal Discomfort*:: Subjects were asked to keep a diary on comfort three times a day for two weeks before the intervention and for 2 weeks at 2 months and 10 months post intervention. Subjects were asked to rate discomfort in various head, neck and upper limb locations on a scale of 1 (feels good) to 5 (feels very uncomfortable).
4. *Musculoskeletal Strain and Pain*: Subjects were measured at baseline and at 10 month follow up on a questionnaire, which included questions on musculoskeletal strain and pain experienced during the preceding 30 days. Strain was assessed on a 5-point scale from 1 (no strain at all) to 5 (very much strain). Presence of pain was assessed as the number of days with or without pain.

Results
Changes in workstation ergonomics
Descriptive statistics demonstrate that changes in screen height, keyboard desk height and the acquisition of wrist and forearm supports were more frequent in the intensive ergonomics group. Adjustments for chair and mouse location were common across all three groups. No tests for statistical significance were conducted on these results.

Changes in ratings of workstation ergonomics
Intensive ergonomics group compared to reference group.
Ratings of workstation ergonomics were similar at baseline for both groups. At 2-month post intervention the intensive ergonomics group had a statistically significant higher rating in workstation ergonomics ($p = 0.001$). The size of the difference in ratings between the two groups was 0.9 of a point on a 7-point ergonomic rating scale. At 10 months post intervention the intensive ergonomics group had a statistically significant higher rating in workstation ergonomics ($p = 0.002$). The size of the difference in ratings between the two groups was 0. 7 of a point on a 7-point ergonomic rating scale.

Education group compared to the reference group.
Ratings of workstation ergonomics were similar at baseline for both groups. There were no statistically significant differences between the two groups at either 2 months or 10 months post intervention.

Changes in ratings of musculoskeletal discomfort.
Intensive ergonomics group compared to reference group.
At 2 months post intervention, the intensive ergonomics group had statistically significantly less discomfort in the neck ($p = 0.014$), the area between the neck and right shoulder ($p = 0.007$), right shoulder ($p = 0.022$), left shoulder ($p = 0.025$), left fingers ($p = 0.017$) and the upper back ($p = 0.001$). The size of the differences between the two groups ranged from 0.5 – 0.7 of a point on a five point scale of discomfort. There were no statistically significant differences between the two groups at 10 months post intervention.

Education group compared to the reference group.
At 2 months post intervention, the education group had statistically significantly less discomfort in the neck ($p = 0.013$), the area between the neck and right shoulder ($p = 0.002$), the right forearm ($p = 0.009$), and the upper back ($p = 0.005$).

The size of the differences between the two groups ranged from 0.5 – 0.6 of a point on a five point scale of discomfort. There were no statistically significant differences between the two groups at 10 months post intervention.

Musculoskeletal strain and pain
There were no statistically significant differences between the groups on reported musculoskeletal strain or pain during the preceding 30 days, at 10 months post intervention.

Authors Conclusions
Both the intensive ergonomics approach and the education in ergonomics help reduce discomfort in VDU work.

Reviewer Appraisal Comments

Validity (Methodology, rigour, selection, biases)
- Subjects were chosen on the basis of their reported musculoskeletal symptoms, mouse usage and age.
- Subjects were allocated into the three groups using stratified random allocation.
- No details provided on how the randomisation schedule was developed and implemented.
- Groups well balanced at commencement of study with no differences between the groups apparent.
- No information provided re blinding of subjects. Unknown if random allocation conducted under blind conditions. There was blinding of the assessors of workstation ergonomic ratings.
- Low drop out rate and all subjects accounted for at the study conclusion.
- No information provided regarding the use of intention to treat analysis.
- All subjects followed up and data collected in same way.
- No comment from authors re the adequacy of the sample size and if the study has sufficient power to obtain statistically significant results.

Results (Favourable or unfavourable, specific outcomes of interest, size of treatment effect, stat. and clinical significance)
- Statistical analysis provided for between groups differences. Between groups analysis conducted for differences between the intensive ergonomic group and the reference group and for the education group and the reference group only.
- No between groups analysis was conducted for differences between the two intervention groups making comparisons between the two interventions difficult. Comparison of means for the intensive ergonomic group and the education group at 2-month and 10 month post intervention reveal minimal differences in results between these two groups.
- P values reported for the majority of results.
- Confidence intervals not provided for any results.
- Although some of the reported results are statistically significant, the size of the treatment effect indicates only small positive changes in workstation ergonomics and musculoskeletal discomfort between the intervention groups and the reference group.
- No information provided on the costs of providing the interventions.

Table 4. Description and Appraisal of RCT by Rizzo et al (1997)

Objective of Study
To examine the impact and effectiveness of educational interventions/ergonomic training on immediate and long-term knowledge and computer related work practices among computer users within a private corporation. Pre intervention sample size estimated to be 150 with approximately 50 participants allocated to each of the three groups.

Intervention Investigated
- Group A: 60 minute ergonomics educational seminar led by a trained instructor comprising a presentation, watching of two videos, provision of written information and group discussion. Content focussed on risk factors for cumulative trauma disorders, recommended workstation adjustments and recommended breaks and exercise.
- Group B: 45-minute self-directed seminar involving watching of two videos and the provision of written information.
- Group C: Control group who received no intervention.

Population
Office based workers who work at a computer for more than 4 hours per 12-hour period.

Primary Outcome Measures
1. Changes in immediate and long term knowledge (at 15 month follow up) of ergonomic principles, measured via a 22 question multiple choice knowledge test.
2. Changes in immediate and long term (at 15 month follow up) personal computer use habits, measured via a 27-point questionnaire (no detail provided on how this was administered).

Baseline measures taken for all three groups prior to the intervention. Immediate measures (taken immediately post intervention) for changes in knowledge taken for Groups A and B only. Long term measures taken for all three groups 15 months post intervention.

Results

Changes in knowledge
Groups A and B both demonstrated statistically significant improvements in immediate and long-term knowledge ($p<0.001$, within group analysis) The control group did not show any significant change in long-term knowledge (no p value given). There were statistically significant differences in the degree of long term knowledge change between Group A and the control group ($p<0.05$). The size of this difference is equal to 4.7 correct answers on the 22-point test. There were statistically significant differences in the degree of long-term knowledge change between Group B and the control group ($p<0.05$). The size of this difference is equal to 2.6 correct answers on the 22 point test. There were no significant differences in the degree of long term knowledge change between Groups A and B (no p value given).

Changes in computer use and work habits
Groups A and B demonstrated statistically significant changes in reported computer use and work habits at 15 months follow up ($p,< 0.001$, within groups analysis). The control group did not show any improvement or change (no p value given). Statistically significant differences were found between Group A and the control group ($p< 0.05$). The size of this difference is equal to 2.8 items on a 27-item questionnaire. There were statistically significant differences between Group B and the control group ($p< 0.05$). The size of this difference is equal to 2.0 items on the 27 item questionnaire There were no statistically significant differences between Groups A and B (no p value given)

Authors Conclusions
Ergonomic training programs increased user knowledge and the number of self reported workstation adjustments and work habits. Ergonomic training programs can be effective as a preventative health promotion measure to increase employee knowledge of cumulative trauma disorders risk factors and solutions, resulting in changed intentions, altered risk behaviour and self reported benefits.

Appraisal Comments
Validity (Methodology, rigour, selection, biases)
- Participants assigned to the experimental or control groups according to the building that they worked in.
- Three buildings allocated randomly to either Group A, Group B or the Control Group but unclear how the randomisation occurred.
- Participant eligibility criteria established and groups were comparable both for the number of employees and the type of worked performed. No other demographic or comparison data provided.
- No information provided re blinding of subjects or researchers.

- 50% drop out rate due to company lay offs and transfers. Analysis of results based on following sample sizes:
  Group A: N = 28
  Group B: N = 22
  Group C: N = 17

- All participants treated same way except for the interventions under investigation.
- No power calculations provided so cannot comment on adequacy of sample size, authors state that this is a pilot project only.

Results (Favourable or unfavourable, specific outcomes of interest, size of treatment effect, stat. and clinical significance)

- No confidence intervals provided for estimation of the size of the treatment effect between Group A and the control group and Group B and the control group. These have been estimated as follows:

Changes in participant knowledge at 15 month follow up:
Group A and Control: Size of treatment effect is 4.7 correct answers on the knowledge test of 22 items, (95%CI = 2.54 – 6.86)*
Group B and Control: Size of treatment effect is 2.6 correct answers on the knowledge test of 22 items (95%CI = 0.32 – 4.88)*

Changes in participant computer use and work habits at 15 month follow up:
Group A and Control: Size of treatment effect is 2.8 items on a 27 point questionnaire, (95% CI = 1.66 – 3.94)*
Group B and Control: Size of treatment effect is 2.0 items on a 27 point questionnaire, (95% CI = 0.98 – 3.02)*

- Although these results are statistically significant, the size of the treatment effect and associated confidence intervals indicate only small positive improvements in knowledge and work habits between the experimental groups and the control group.
- No information on program costs provided.

* Reviewer calculations

References

1. National Health and Medical Research Council. (2000) How to use the evidence: assessment and application of scientific evidence. Handbook series on preparing clinical practice guidelines. Canberra: Commonwealth of Australia.

Articles critically appraised for this summary of evidence

Level II Evidence

1. Brisson, C., Montreuil, S., & Punnett, L. (1999). Effects of an ergonomic training program on workers with video display units. *Scandinavian Journal of Work Environment & Health*, 25(3), 255 – 263.

2. Ketola, R., Toivonen, R., Hakkanen, M., Luukkonen, R., Takala E., Viikari-Juntura, E. (2002). Effects of ergonomic intervention in work with video display units. *Scandinavian Journal of Work Environment & Health.*, 28(1), 18 – 24.

3. Rizzo, T.H., Pelletier, K.R., Serxner, S., & Chikamoto, Y. (1997). Reducing risk factors for cumulative trauma disorders (CTDs): The impact of preventive ergonomic training on knowledge, intentions and practices related to computer use. *American Journal of Health Promotion*, 11(4), 250 – 253.

Related articles not included in the appraisal

Level III Evidence

1. Oxenburgh, M.S., Rowe, S.A., & Douglas, D.B. (1985). Repetition strain injury in keyboard operators - Successful management over a two-year period. *The Journal of Occupational Health and Safety – Australia and New Zealand*, 1(2), 106 – 112.

Level IV Evidence

1. Green, R.A., & Briggs C.A. (1989). Effect of overuse injury and the importance of training on the use of adjustable workstations by keyboard operators. *Journal of Occupational Medicine*, 31(6), 557 – 562.

2. Hochanadel, C.D. (1995). Computer workstation adjustment: A novel process and large sample study. *Applied Ergonomics*, 26(5), 315 – 326.

3. McCann, K.B., Sulzer Azaroff, B. (1996). Cumulative trauma disorders: Behavioural injury prevention at work. *Journal of Applied Behavioural Science*, 32(3), 277 – 291.

4. Rizzo, T.H. (1993). Office ergonomics education: A health promotion program at Stanford University. *American Journal of Health Promotion*, 8(1), 15 – 18.

5. Trudel, L., & Montreuil, S. (1999). Understanding the transfer of knowledge and skills from training to preventative action using ergonomic work analysis with 11 female VDT users. *Work: A Journal of Prevention, Assessment & Rehabilitation*, 13(3), 171 – 183.

Level V Evidence

1. Fisher, T.F. (1998), Preventing upper extremity cumulative trauma disorders: An approach to employee wellness. *American Association of Occupational Health Nurses Journal*, 46(6), 296 – 301.

2. Keller, K., Corbett, J., & Nichols, D. (1998). Repetitive strain injury in computer keyboard users: Pathomechanics and treatment principles in individual and group intervention. *Journal of Hand Therapy,* 11(1), 9 – 26.

3. Leonard – Dolack, D.M. (2000). The effectiveness of intervention strategies used to educate clients about prevention of upper extremity cumulative trauma disorders. *Work: A Journal of Prevention, Assessment & Rehabilitation*, 14(2), 151 – 157.

4. Lind, J.S. (2002). Musculoskeletal disorders among video display terminal operators. *Applied Occupational and Environmental Hygiene,* 17(1), 18 – 21.

5. National Occupational Health and Safety Commission. (1994). National Code of Practice for the prevention and management of occupational overuse syndrome. Report no: 2013. Canberra: Commonwealth Government of Australia.