The effectiveness of a work style intervention and a lifestyle physical activity intervention on the recovery from neck and upper limb symptoms in computer workers

Claire M. Bernaards, Geertje A.M. Ariëns, Dirk L. Knol, Vincent H. Hildebrandt

Abstract

This study assessed the effectiveness of a single intervention targeting work style and a combined intervention targeting work style and physical activity on the recovery from neck and upper limb symptoms. Computer workers with frequent or long-term neck and upper limb symptoms were randomised into the work style group (WS, n = 152), work style and physical activity group (WSPA, n = 156), or usual care group (n = 158). The WS and WSPA group attended six group meetings. All meetings focused on behavioural change with regard to body posture, workplace adjustment, breaks and coping with high work demands (WS and WSPA group) and physical activity (WSPA group). Pain, disability at work, days with symptoms and months without symptoms were measured at baseline and after 6 (T1) and 12 months (T2). Self-reported recovery was assessed at T1/T2. Both interventions were ineffective in improving recovery. The work style intervention but not the combined intervention was effective in reducing all pain measures. These effects were present in the neck/shoulder, not in the arm/wrist/hand. For the neck/shoulder, the work style intervention group also showed an increased recovery-rate. Total physical activity increased in all study groups but no differences between groups were observed. To conclude, a group-based work style intervention focused on behavioural change was effective in improving recovery from neck/shoulder symptoms and reducing pain on the long-term. The combined intervention was ineffective in increasing total physical activity. Therefore we cannot draw conclusions on the effect of increasing physical activity on the recovery from neck and upper limb symptoms.

Keywords: Neck and upper limb symptoms; Computer workers; Work style; Lifestyle physical activity intervention; Behavioural change

1. Introduction

Neck and upper limb symptoms are frequently reported by computer workers. In the year 2002, 28% of the general Dutch working population suffered from pain or stiffness in the neck, shoulder, arms, hands or wrists in the previous 12 months (Heinrich and Blatter, 2002).
A survey conducted in 15 European countries showed a prevalence of 25% for work-related neck/shoulder pain and a prevalence of 15% for work-related arm pain (De Kraker and Blatter, 2005). The total yearly costs of neck and upper limb symptoms in the Netherlands due to decreased productivity, sick leave, chronic disability for work and medical costs were recently estimated at 2.1 billion euros (Blatter et al., 2006). Recent conservative estimates of the cost to the U.S. economy for all musculoskeletal disorders range from $45 to $54 billion annually (NSR/IOM).

Neck and upper limb symptoms have a multi-fac-torial aetiology. However, primary and secondary intervention studies have primarily focused on physical components of the workplace like ergonomics and workstation adjustment (Ketola et al., 2002; Gerr et al., 2005; Brewer et al., 2006; Rempel et al., 2006). A recent review study found no strong evidence for the effectiveness of any type of workplace intervention, partly because of the heterogeneity of workplace interventions (Brewer et al., 2006).

The effectiveness of exercise programs has been studied as well but most of these programs showed only short-term effects (i.e. up to 2–4 months) on neck and shoulder symptoms (Levoska and Keinanen-Kiukaanniemi, 1993; Taimela et al., 2000; Waling et al., 2002; Sjögren et al., 2005). This might be due to lack of adherence to exercise programs. Lifestyle physical activity interventions, on the other hand, aiming to increase physical activity up to at least 30 min per day, seem to be promising with regard to the maintenance of physical activity (Dunn et al., 1998). Yet no data are available with regard to their effects on neck and upper limb symptoms.

In recent years attention has shifted from single interventions to multi-component interventions or “integra-tive” interventions that include both biomechanical and psychosocial components (Cole et al., 2006). Work style has been proposed as a mechanism by which ergonomic and psychosocial risk factors interact to affect the development, exacerbation and/or maintenance of neck and upper limb symptoms (Feuerstein, 1996). Work style is predictive of future pain and functional limitations in office workers with neck and upper limb symptoms (Nicholas et al., 2005) but little is known on the effectiveness of improving work style behaviour (Bongers et al., 2006).

The aim of our study was to assess the effectiveness of a single intervention targeting work style and a combined intervention targeting work style and physical activity on the recovery from neck and upper limb symptoms of computer workers. Based on the dynamic workload model, which assumes that health effects result from an imbalance between workload and capacity (Van Dijk et al., 1990), we hypothesize that our combined intervention will be more effective than our single intervention.

2. Methods

2.1. Design and study population

The RSI@Work study is a Randomised Controlled Trial (RCT) with two intervention groups and a usual care group, an intervention period of 6 months and measurements at baseline and after 6 and 12 months of follow-up. The source population for this study consisted of computer workers (N = ±8000) from the head-offices of 7 Dutch companies in various branches (e.g. insurance, science, energy, transportation policy and taxes) in different regions of the Netherlands. The researchers used a short questionnaire to select workers who were eligible for participation in the study. This questionnaire was specially developed for this purpose. The following inclusion criteria were used:

1. Frequent (i.e. at least once a week) or long-term pain, stiffness or tingles in neck, shoulders, arms, wrists and/or hands.
2. Performing computer work for at least 3 days a week during at least 3 h a day.
3. A working contract until the last follow-up measurement.
4. Not under treatment of a doctor or (physical) therapist for complaints in the neck, shoulders, arms, wrists and/or hands.
5. No non-work-related or clear somatic diseases (e.g. rheumatoid arthritis, cervical hernia, tennis elbow, carpal tunnel syndrome).
6. Sickness absence of less than 50% of the total working time (i.e. worker is currently working at least 50% of the hours he or she is supposed to work according to his or her working contract).

All workers who gave informed consent and completed the baseline questionnaire were randomised into the 1. Work style group (WS group), 2. Work style and physical activity group (WSPA) or 3. Usual care group.

The study was approved by the Medical Ethics Committee of the VU University Medical Center. The baseline measurements and follow-up measurements were conducted in October 2004 (baseline), April 2005 (6 months follow-up) and October 2005 (12 months follow-up). A detailed description of the study design and study population has been published elsewhere (Bernaards et al., 2006).

2.2. Treatment allocation and blinding

An independent statistician prepared the randomisation by using a computer-generated randomisation. To prevent unbalanced randomisation, workers were pre-stratified by company and self-reported sports participation assessed with the baseline questionnaire. Furthermore, block randomisation with blocks of three was used. The researchers informed participants about their treatment allocation directly after they completed their baseline measurements. Workers who did not
participate in the baseline measurements but sent their completed questionnaire and informed consent by post were randomised at the VU university medical center and were informed about their treatment allocation by phone or by email. Unfortunately it was impossible to blind participants and counsellors for the treatment allocation. However, the researchers who performed the follow-up measurements were not aware of the treatment allocation of participants except for the counsellors who also performed part of the measurements.

2.3. Interventions

Like previous lifestyle physical activity intervention studies (Dunn et al., 1998), the RSI@Work interventions were based on theoretical models of behaviour change, i.e. the Trans Theoretical Model (TTM) (Prochaska et al., 1992) and the Precaution Adoption Process Model (PAPM) (Weinstein et al., 1998). Concepts of the PAPM and TTM, such as stage of change, awareness, self-efficacy and decisional balance, were used in the group meetings and applied to both the WS group and the WSPA group. The goal of the interventions was behavioural change. For the work style intervention this concerned behavioural changes with regard to body posture, workplace adjustment, breaks and coping with high work demands. For the lifestyle physical activity intervention this concerned behavioural change with regard to the engagement in moderate to heavy intensity physical activities. Physical exercise was not part of the intervention itself.

The interventions for the two intervention groups both consisted of six interactive group meetings in a 6-month period. Time between group meetings was about 1 month. Both intervention groups attended four large group meetings (with maximally 10 participants) and two small group meetings (with maximally three participants). The duration of the large group meetings was 1.5 h in the WSPA group and 1.0 h in the WS group. The duration of the small group meetings was 45 min in the WSPA group and 30 min in the WS group. All group meetings took place at the workplace, during work time (with permission of the employee) and under the supervision of a specially trained counsellor. The counsellors used standardized protocols that had been tested and improved during the pilot study. Four out of six meetings were large group meetings with maximally 10 participants. Two out of six meetings were small group meetings with maximally four participants. The goal of all group meetings was behavioural change with regard to physical activity and/or work style. The goal of the large group meetings was to provide general information and to raise awareness about work style and/or physical activity, and to discuss and find solutions for general barriers with regard to behavioural change. The goal of the small group meetings was to provide participants with tailored advice based on their stage of change with regard to work style and/or physical activity. In addition, solutions for individual barriers with regard to behavioural change were discussed.

The counsellor provided the work style part to both intervention groups and the physical activity part to the WSPA group only. The group meetings of the WSPA group were separated from the group meetings of the WS group. Participants in the usual care group did not attend any of the group meetings. A detailed description of each group meeting has been published elsewhere (Bernaards et al., 2006).

2.4. Measurements

All outcome measures, except for degree of recovery, were assessed three times: at baseline, at 6 months of follow-up (i.e. directly after the intervention period), and at 12 months of follow-up. Degree of recovery was assessed at both follow-up measurements.

2.5. Primary outcome measures

Degree of recovery, pain intensity, disability at work and number of days with neck and upper limb symptoms were assessed separately for the neck/shoulder region and the arm/wrist/hand region. For the primary analyses overall estimates were constructed reflecting recovery, pain, disability and number of days with neck and upper limb symptoms independently of body region.

1. Degree of recovery. Degree of recovery from neck and upper limb symptoms was assessed using a 7-point VAS scale ranging from “much worse” to “completely recovered” compared to baseline. Participants were considered to be recovered when they indicated to have completely or much recovered in both body regions.

2. Pain intensity. Current pain, average pain, and worst pain in the past 4 weeks were assessed using a validated 11-point numerical scale rating scale ranging from 0 “no pain” to 10 “worst pain ever” (Von Korff et al., 1992). Overall pain measures were constructed by using the highest score in either the neck/shoulder region or the arm/wrist/hand region.

3. Disability at work. Change in ability to work in the past 4 weeks was assessed with a validated 11-point numerical rating scale ranging from 0 “no change” to 10 “extreme change” (Von Korff et al., 1992). Participants were considered to be disabled at work when they reported disability in at least one of the two body regions.

4. Number of days with neck and upper limb symptoms. Participants reported the number of days with neck/shoulder symptoms and arm/wrist/hand symptoms in the past 6 months (no symptoms, 1–7 days, 8–30 days, 31–90 days, 91–180 days) and the past week (no symptoms, 1 day, 2–3 days, 4–7 days) using the validated Dutch Musculoskeletal questionnaire (Hildebrandt et al., 2001). Overall estimates were constructed using the highest answering category in either the neck/shoulder region or the arm/wrist/hand region.

5. Number of months without symptoms. The number of months without neck and upper limb symptoms in the past 6 months was assessed using one single question: “In how many of the past 6 months did you have no symptoms in neck and upper extremities? Answering categories ranged from 0 to 6 months. Overall estimates were constructed using the highest answering category in either the neck/shoulder region or the arm/wrist/hand region.
2.6. Secondary outcome measures

2.6.1. Physical activity

Physical activity was assessed by means of the validated Short Questionnaire to Access health enhancing physical activity (SQUASH) (Wendel-Vos et al., 2003). The SQUASH questionnaire contains questions about activities in the following four domains: (1) commuting activities (i.e. walking and cycling), (2) activities at work and school, (3) household activities, and (4) leisure time activities (i.e. walking, cycling, gardening, chores, and sports). With SQUASH the number of minutes spent on moderate intensity physical activity (4-6.5 MET), and total physical activity (≥4 MET) was calculated and expressed in minutes per week.

2.6.2. Health care use

At baseline participants were asked whether or not they ever sought medical help for neck and upper limb symptoms. In addition, they were asked to indicate which health care provider(s) they visited. Answering categories were: (1) occupational physician or occupational therapist, (2) general practitioner, (3) physiotherapist, exercise therapist or manual therapist, (4) psychosocial therapist, (5) specialist, (6) alternative healer, (7) other. At both follow-up measurements participants were asked again whether or not they sought medical help for neck and upper limb symptoms in the past 6 months and which health care provider(s) they visited.

2.6.3. Work style

In the present study, we will not report any of the changes in work style components since this was beyond the scope of the present paper. The measurement of work style components has been described in Bernaards et al. (2006).

2.6.4. Individual actions to reduce neck and upper limb symptoms

The first follow-up questionnaire contained questions about actions performed to reduce neck and upper limb symptoms in the past 6 months. Participants could indicate more than one action from a list of 20 actions (e.g. adjustment of workplace, increase in the number of breaks, increase in physical activity at work).

2.7. Covariates

At baseline data were collected on age, gender, years of computer work, education and duration of neck and upper limb symptoms, body height, and body weight.

2.8. Data analysis

Intention-to-treat analyses were used to estimate the effect of the intervention. This means that all participants who were randomly assigned to one of the two intervention groups were included in the analyses regardless of whether they attended the group meetings. To examine the success of randomisation, descriptive statistics were used to compare baseline characteristics.

2.8.1. Primary analyses

Multilevel analyses (MLwiN version 2.02) were used to study differences in recovery and changes in primary outcome measures between the intervention groups and the usual care group at T1 and T2, using dummy variables for group and time of measurement. Multilevel analyses were used in order to adjust for possible dependency between observations of workers from the same company or for possible dependency between repeated measurements within workers. The data of this study were clustered at three levels: company, worker and time of measurement. The interaction between group and time of measurement represents the intervention effect over time for each intervention group compared to the usual care group adjusted for baseline values of the outcome measure. In case differences in other baseline characteristics were observed, adjusted multilevel analyses were conducted in order to check for confounding.

Proportional odds models were used to study intervention effects on ordinal primary outcome measures, i.e. number of days with neck and upper limb symptoms in the past week and the past 6 months, and the number of months without symptoms. Results from these so-called ordered multinomial regression analyses can be interpreted as cumulative odds ratios (McCullagh, 1980). In our proportional odds model, cumulative odds ratios above 1 indicate a shift from a high number of days with symptoms to a low number of days with symptoms or a shift from a high number of months without symptoms to a low number of months without symptoms.

2.8.2. Stratified analyses for body region

Stratified multilevel analyses were conducted to study the effects on pain and recovery separately for the neck/shoulder region and the arm/wrist/hand region.

2.8.3. Secondary analyses

Multilevel analyses (MLwiN version 2.02) were used to study changes in physical activity between the intervention groups and the usual care group at T1 and T2. Chi-square analyses (p < 0.05) were used in SPSS to study differences in health care use between the study groups during the 6 months intervention period. Chi-square analyses (p < 0.05) were also used to study differences in individual actions to reduce neck and upper limb symptoms between the study groups.

2.8.4. Power calculation

The number of participants in each group needed to detect a difference in recovery of 20% between the intervention group and the usual care group was ±80, with a = 0.05 and β = 0.20. This number was based on our expectation that recovery would be 80% in the intervention group and 60% in the usual care group. Since we expected a loss-to-follow-up of 40%, ±135 workers were needed in each group at baseline.

3. Results

3.1. Participant flow and baseline characteristics

Approximately 8000 workers were invited to participate in the RSI@Work study of which 466 were randomised into the trial (Fig. 1). None of the
participants reported neck and upper limb symptoms in the past 2 weeks only. Follow-up information was obtained from 84% (n = 392) of participants at 6 months of follow-up (T1) and from 68% (n = 318) at 12 months of follow-up (T2). Fig. 1 presents reasons for withdrawal of participants who officially quit to participate during the intervention period (n = 41). There were also participants who did not quit officially during the intervention period but who did not complete all follow-up measurements. Dropouts were defined as participants who did not fill out the final follow-up measurements (n = 148). Dropouts were younger on average and had a shorter history of computer work than participants who filled out the final questionnaire. They also reported higher pain levels at baseline and less strenuous intensity physical activities. Furthermore,
females dropped out more frequently than men. The number of withdrawals during the intervention period was highest in the WSPA group.

Table 1 shows that baseline characteristics of participants were largely similar in all three study groups. Small differences were observed for level of education and months since first symptoms. Adjustment for these variables in multilevel analyses yielded similar results as unadjusted multilevel analyses. Therefore, we present only results from multilevel analyses adjusted for baseline values of outcome measures. Table 2 presents the number of participants that attended 0, 1, 2, 3, 4, 5 or 6 group meetings in both intervention groups. The number of participants that attended at least three group meetings was rather similar in the WS group (82%) and the WSPA group (78%).

3.2. Effect of interventions on primary outcomes

Tables 3 and 4 present the scores of the primary outcome variables at baseline and the two follow-up measurements as well as the intervention effect over time between the groups estimated with multilevel analyses. In general the single work style intervention was effective in reducing all pain outcomes, whereas the combined work style and physical activity intervention was not. Interestingly the work style intervention was only effective on the long-term (i.e. after 12 months of follow-up) and not on the short-term (i.e. after 6 months of follow-up).

3.2.1. Recovery and disability at work

Although changes in recovery and disability at work after 12 months of follow-up were more favourable in the intervention groups than in the usual care group, none of these effects were statistically significant (Table 3).

Table 2
Number of participants that attended 0, 1, 2, 3, 4, 5 or 6 group meetings in the work style group (WS) and the work style and physical activity group (WSPA)

<table>
<thead>
<tr>
<th>Number of meetings attended</th>
<th>WS</th>
<th>WSPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3 (2.0)</td>
<td>8 (5.1)</td>
</tr>
<tr>
<td>1</td>
<td>6 (3.9)</td>
<td>12 (7.7)</td>
</tr>
<tr>
<td>2</td>
<td>19 (12.3)</td>
<td>14 (9.0)</td>
</tr>
<tr>
<td>3</td>
<td>14 (9.2)</td>
<td>26 (16.7)</td>
</tr>
<tr>
<td>4</td>
<td>30 (19.7)</td>
<td>34 (21.8)</td>
</tr>
<tr>
<td>5</td>
<td>61 (40.1)</td>
<td>45 (28.8)</td>
</tr>
<tr>
<td>6</td>
<td>19 (12.5)</td>
<td>17 (10.9)</td>
</tr>
</tbody>
</table>

Percentage is presented between brackets.

3.2.2. Pain

After 6 months of follow-up, no significant intervention effect over time was found for current pain, average pain or worst pain (Table 3). However, after 12 months of follow-up a significant negative intervention effect over time was found for all pain measures for the WS group compared to the usual care group but not for the WSPA group compared to the usual care group. This means that during the 1-year follow-up all pain measures reduced significantly in the WS group compared to the usual care group.

3.2.3. Number of days with symptoms in the past week and past 6 months

At both follow-up measurements no significant intervention effect over time was found for the number of days with neck and upper limb symptoms (Table 4).

3.2.4. Months without symptoms

At both follow-up measurements no significant intervention effect over time was found for the number of months without symptoms (Table 4).
Stratified analyses for body region

Stratified analyses showed different intervention effects in the neck/shoulder region than in the arm/wrist/hand region (Table 5). There was no significant intervention effect over time for pain and recovery in the arm/wrist/hand region. In the neck/shoulder region, on the other hand, all pain measures reduced significantly in the WS group compared to the usual care group between baseline and 12 months of follow-up. In the same period, average pain in the neck/shoulder region reduced significantly more in the WSPA group compared to the usual care group. Furthermore, the rate of recovery from neck/shoulder symptoms was significantly higher in the work style group compared to the usual care group at both follow-up measurements.

Effects of interventions on secondary outcomes

Self-reported physical activity

At both follow-up measurements no significant intervention effect over time was found for total physical activity. The mean estimated difference in total physical activity over time between the WSPA and the usual care group was 42.2 min per week (95% C.I. −46.3; 130.6) at 6 months of follow-up and 37.7 min per week (95% C.I. −58.1; 133.6) at 12 months of follow-up. Although no differences were observed between study groups, all study groups showed an increase in total physical activity between baseline and 6 months of follow-up (mean difference: 57.7 min per week, 95% C.I. 21.6; 93.8) and between baseline and 12 months of follow-up (mean difference: 51.9 minutes per week, 95% C.I. 13.0; 90.9).

Use of health care system

During the 6 months intervention period, 38% of the participants from the usual care group sought medical help for neck and upper limb symptoms compared to 18% from the WS group and 21% from the WSPA group. This difference was statistically significant ($\chi^2 = 10.7$ (df 2), $p < 0.01$). The therapist (e.g. physiotherapist) and general practitioner were most frequently visited by all study groups.

Individual actions to reduce neck and upper limb symptoms

After 6 months of follow-up, participants from the intervention groups reported more individual actions to reduce neck and upper limb symptoms than participants from the usual care group. Significant differences between the groups were found for ergonomic changes (WS: 72.2%, WSPA: 64.3%, usual care: 25.6%), body posture and workplace adjustment (WS: 57.9%, WSPA: 61.1%, usual care: 24.1%), increase in physical activity at
Table 4
Ordinal primary outcome measures at baseline (T0) and at follow-up and differences over time between the groups

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Work style group (WS)</th>
<th>Work style and physical activity group (WSPA)</th>
<th>Usual care group</th>
<th>Intervention effect over time&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T0</td>
<td>T1</td>
<td>T2</td>
<td>T0</td>
</tr>
<tr>
<td>Number of days with symptoms (past 6 months)</td>
<td>N = 152</td>
<td>N = 133</td>
<td>N = 109</td>
<td>N = 156</td>
</tr>
<tr>
<td>0</td>
<td>0.0</td>
<td>1.5</td>
<td>6.4</td>
<td>0.0</td>
</tr>
<tr>
<td>1–7</td>
<td>6.6</td>
<td>21.1</td>
<td>29.4</td>
<td>6.4</td>
</tr>
<tr>
<td>8–30</td>
<td>28.9</td>
<td>34.6</td>
<td>25.7</td>
<td>32.7</td>
</tr>
<tr>
<td>31–90</td>
<td>30.3</td>
<td>21.8</td>
<td>22.9</td>
<td>33.3</td>
</tr>
<tr>
<td>91–180</td>
<td>34.2</td>
<td>21.1</td>
<td>15.6</td>
<td>27.6</td>
</tr>
<tr>
<td>Number of days with symptoms (past week)</td>
<td>N = 152</td>
<td>N = 133</td>
<td>N = 109</td>
<td>N = 156</td>
</tr>
<tr>
<td>0</td>
<td>5.3</td>
<td>24.1</td>
<td>24.8</td>
<td>9.0</td>
</tr>
<tr>
<td>1</td>
<td>17.8</td>
<td>21.1</td>
<td>26.6</td>
<td>15.4</td>
</tr>
<tr>
<td>2–3</td>
<td>27.6</td>
<td>24.1</td>
<td>24.8</td>
<td>34.0</td>
</tr>
<tr>
<td>4–7</td>
<td>49.3</td>
<td>30.8</td>
<td>23.9</td>
<td>41.7</td>
</tr>
<tr>
<td>Months without symptoms (0–6)</td>
<td>N = 150</td>
<td>N = 132</td>
<td>N = 108</td>
<td>N = 155</td>
</tr>
<tr>
<td>0</td>
<td>54.0</td>
<td>50.0</td>
<td>36.1</td>
<td>56.1</td>
</tr>
<tr>
<td>1–2</td>
<td>32.0</td>
<td>22.7</td>
<td>25.9</td>
<td>24.5</td>
</tr>
<tr>
<td>3–6</td>
<td>14.0</td>
<td>27.3</td>
<td>38.0</td>
<td>19.4</td>
</tr>
</tbody>
</table>

All numbers are percentages unless stated otherwise. 95% C.I., 95% confidence interval.

<sup>a</sup> Results of longitudinal multilevel analyses on the effectiveness of the RSI@Work intervention at 6 (T1) and 12 months of follow-up (T2).
Table 5
Results from the stratified analyses

<table>
<thead>
<tr>
<th></th>
<th>Neck/shoulder</th>
<th>Arm/wrist/hand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WS versus usual care</td>
<td>WSPA versus usual care</td>
</tr>
<tr>
<td></td>
<td>N (WS/control)</td>
<td>Mean difference (95% C.I.)</td>
</tr>
<tr>
<td>Interventions effect over time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 months follow-up</td>
<td>132/132</td>
<td>0.01 (–0.54; 0.56)</td>
</tr>
<tr>
<td>12 months follow-up</td>
<td>108/100</td>
<td>–0.66 (–1.26; –0.06)</td>
</tr>
<tr>
<td>Worst pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 months follow-up</td>
<td>131/133</td>
<td>0.04 (–0.63; 0.71)</td>
</tr>
<tr>
<td>12 months follow-up</td>
<td>108/100</td>
<td>–1.02 (–1.76; –0.29)</td>
</tr>
<tr>
<td>Average pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 months follow-up</td>
<td>131/133</td>
<td>–0.16 (–0.69; 0.37)</td>
</tr>
<tr>
<td>12 months follow-up</td>
<td>108/100</td>
<td>–0.86 (–1.44; –0.29)</td>
</tr>
<tr>
<td>Recovery</td>
<td></td>
<td>Odds ratio (95% C.I.)</td>
</tr>
<tr>
<td>Baseline</td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>6 months follow-up</td>
<td>122/121</td>
<td>3.10 (1.53; 6.29)</td>
</tr>
<tr>
<td>12 months follow-up</td>
<td>97/89</td>
<td>2.94 (1.31; 6.58)</td>
</tr>
</tbody>
</table>

Differences in pain and recovery over time between the groups. 95% C.I., 95% confidence interval.

* Results of longitudinal multilevel analyses on the effectiveness of the RSI@Work intervention at six and 12 months of follow-up.

* p < 0.05.
work (WS:23.3%, WSPA: 29.4%, usual care: 12.0%), increase in leisure time physical activity (WS: 34.6%, WSPA: 47.6%, usual care: 22.6%), and search for information on work stress and work demands (WS: 9.8%, WSPA: 16.7%, usual care: 5.3%).

3.4.4. Additional analyses

In order to explore the possible role of physical activity on pain reduction we conducted a linear regression analysis between changes in physical activity and changes in pain outcomes in the total study population. No association was found. The results for moderate intensity physical activity, strenuous intensity physical activity and total physical activity were similar. When only sports activities were considered, we found a small but significant association between sports activities (per 100 min per week) and pain outcomes independently of study group and pain at baseline (β = −0.12, 95% C.I. −0.23; −0.01 for current pain); β = −0.16, 95% C.I. −0.30; −0.03 for worst pain; (β = −0.13, 95% C.I. −0.25; −0.02 for average pain).

4. Discussion

The goal of the present study was to assess the effectiveness of a single work style intervention and a combined intervention targeting work style and physical activity on the recovery from neck and upper limb symptoms of computer workers. The work style intervention was effective in reducing all pain outcomes at 12 months of follow-up but not at 6 months of follow-up. In contrast, the combined intervention had no effect on any of the primary outcome measures. Stratified analyses showed that the work style intervention was only effective in workers with neck/shoulder symptoms and not in workers with arm/wrist/hand symptoms. The extra focus in the combined intervention group on physical activity did not result in a greater increase of physical activity. Therefore we cannot draw any conclusions on the effect of increasing physical activity on the recovery from neck and upper limb symptoms.

4.1. Comparison with other work style interventions

In a recent review study Bongers et al. (2006) concluded that behavioural aspects, such as work style, seem to be important in the aetiology of neck and upper limb symptoms. However, few intervention studies have been conducted using this concept (Faucett et al., 2002; Feuerstein et al., 2004; Peper et al., 2004). All work style intervention studies evaluated multi-component interventions with different components which hampers the comparability with our study. Faucett et al. (2002) used small group meetings in order to improve worker’s capabilities with regard to the use of basis ergonomic principles, problem solving, basic muscle relaxation, coping with stress and symptoms. These small group meetings were effective in preventing work-related musculoskeletal disorders of the upper extremity but only at 6 weeks of follow-up. Peper et al. (2004) evaluated the effectiveness of a group based “healthy computing” intervention in a healthy worker population and found a significant reduction in most body symptoms and an improvement in positive work style habits such as taking breaks during computer work. Finally, Feuerstein et al. (2004) compared the effectiveness of a traditional ergonomic approach with that of a combined approach offering a job stress management program with interactive group meetings in addition to a traditional ergonomic approach. Similar as in our study the combined approach was not more effective than the single approach in reducing pain, symptoms and functional limitations.

4.2. Comparison with other physical activity intervention studies

The present study is, to our knowledge, the first study that evaluates the effectiveness of a lifestyle physical activity intervention on the recovery from neck and upper limb symptoms. Other physical activity intervention studies evaluated specific training programs in which physical activity or exercise was part of the intervention, which was not the case in our intervention. Intervention studies that evaluated specific training programs in workers with neck/shoulder symptoms showed mixed results. Some studies showed that workers with neck and shoulder symptoms may benefit from exercise programs (Levoska and Keinanen-Kiukaanniemi, 1993; Taimela et al., 2000; Waling et al., 2002; Ylinen et al., 2003; Tsauo et al., 2004; Chiu et al., 2005; Sjögren et al., 2005) whereas others did not (Takala et al., 1994; Klemetti et al., 1997; Gowans et al., 1999; Horneij et al., 2001; Kjellman and Oberg, 2002; Viljanen et al., 2003). It seems likely that these mixed results are due to the heterogeneity in study populations and/or training programs.

4.3. Explanation of our physical activity findings

Based on the assumption that our lifestyle physical activity intervention would increase physical activity we expected to find higher recovery and pain reductions in the WSPA group compared to the WS group and the usual care group. However since the assumption with regard to physical activity increase was not met, we could not assess the effect of an additional increase of physical activity on pain and recovery. This does not mean that there is no association between physical activity increase and neck and upper limb symptoms. In order to explore the possible role of physical activity and sports activities on pain reduction we conducted additional analyses. The small but significant favourable
effect of sports activities on pain reduction was also reported by two other studies (Cassou et al., 2002; Feleus et al., 2006).

4.4. Effect of group meetings on individual actions

These results with regard to individual actions suggest that the group meetings had some effect on workplace adjustment and the use of breaks. However, all actions were self-reported and could be resulting from a higher awareness in the intervention groups combined with the tendency to give social desirable answers.

4.5. Work style versus combined intervention

The fact that our single intervention was effective in reducing pain outcomes whereas our combined intervention was not is in contrast to our expectations since the work style component was similar in both intervention groups. Group meetings in the WS group and the WSPA group differed only in duration and the number of topics that were treated. One plausible explanation for our findings is that the intervention effect in the WSPA group has been diluted by the fact that more than one message was communicated. Our multi-message might have caused a lack of focus which may have hampered a positive behavioural change in this group. A second explanation might be that group meetings are less suitable for increasing physical activity than for improving work style. This is supported by the relatively high dropout rate during the intervention period in the WSPA group (Fig. 1). However Table 2 suggests that the observed differences in effectiveness of the two interventions cannot be explained by differences in attendance rates between the groups. Surprisingly, the effects found in the WS group were only seen at 12 months of follow-up (i.e. 6 months after the intervention). This is in agreement with the fact that a behavioural change takes its time and effects of a behavioural intervention may thus manifest themselves only on the longer term, in particular in a work setting, where implementation of changes in work, workstation, and work organisation is usually a slow long lasting process.

4.6. Clinical relevance

There is no consensus about which difference on an 11-point VAS scale should be considered clinically important. Although the absolute changes in pain presented in Table 3 are small, they deserve attention considering the relatively low pain levels at baseline. Additional research in practice should be conducted to draw any conclusions on the relevancy of the observed effects.

4.7. Strengths and limitations

The strength of our study is the fact that we used a stage-based approach to improve work style and to increase physical activity. Although stage-based approaches are nowadays very common in lifestyle interventions, they have not been used much in work style interventions. Furthermore, no other study evaluated the effectiveness of a work style and lifestyle physical activity intervention on the recovery from neck and upper limb symptoms. Finally, the number of participants in our study is relatively large.

The most important limitation of our study comes from the fact that our lifestyle physical activity intervention was not effective in increasing physical activity, thereby making it impossible to draw any conclusions on the effectiveness of physical activity increase in the recovery from neck and upper limb symptoms. The second limitation of our study comes from possible contamination that might have occurred since we randomised our participants on the participant’s level and not on company level. In other words, participants from different study groups but from the same company could have met and discussed the group meetings. In this way participants in the usual care group may have become aware of their unhealthy work style or physical activity pattern and changed their behaviour. Nevertheless, the usual care group has not been guided during interactive group meetings which we believe is essential to improve work style and physical activity on the long-term.

4.8. Practical implications, future directions and conclusions

Reducing neck and upper limb symptoms of computer workers is a major task for occupational health care. Low cost solutions that are effective on the long-term are needed but scarce. Our study indicates that an intervention on group level aiming to change work style behaviour is effective in improving recovery from neck/shoulder symptoms and reducing pain on the long-term in computer workers with neck and upper limb symptoms. Such an approach may offer a promising alternative for the classic, more individual orientated ergonomical approach which is often chosen in companies. Future studies, however, should also report the changes in work style parameters in order to understand the actual process of behavioural change.

Combining a group-based work style intervention with a group-based lifestyle physical activity intervention seems to work contra productive. Unfortunately, we cannot draw any conclusions on the effect of increasing physical activity on the recovery from neck and upper limb symptoms since our combined intervention was ineffective in increasing physical activity. For future studies, it might be interesting to investigate the role of individual preferences on compliance and treatment outcome.
References

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