FLEX CEUs

Neck Pain in Office Workers: Consequences and Supervised Training

Consequences and management of neck pain by female office workers: results of a survey and clinical assessment

Abstract

Background: Neck pain is common in office workers. However, the functional consequences of this pain to the individual and how they are managed are not well known. The objective of this study is understand the impact of neck pain and the strategies female office workers use to manage their pain while remaining at work.

Methods: Female office workers with neck pain ($n = 174$) completed a survey about the impact of their neck pain, with 51 attending a university clinic for further assessment. Consequences of neck pain were evaluated with questions on self-reported work absence, workers' compensation claims, health care use, impact on work and leisure activity, and management strategies. Responses to survey questions were analysed using descriptive analyses.

Results: The results showed that during the preceding 12 months, 57.5 % of participants had consulted a health professional due to neck pain; 42 % had reduced their leisure activities; 22.4 % had reduced their work activity and 20.7 % had been absent from work. Only 5.2 % had ever submitted a workers' compensation claim and 9 % indicated changing jobs due to neck pain. Of the 51 participants who attended for further assessment, 35.3 % indicated they 'self-managed' their neck pain with conventional medical strategies. Common strategies utilized were: prescription or over-the-counter medications (82.5 %), physiotherapy (64.7 %) and visiting their general medical practitioner (54.9 %).

Conclusions: Although the severity of neck pain experienced by female office workers in this study was low, the impact on work and leisure was substantial. These workers tended to self-manage their pain by reducing work and/or leisure activity and utilizing passive coping strategies to remain at work. Physiotherapists are ideally suited to provide self-management strategies to ensure workers remain healthy while working.

Keywords: Neck problem, Pain management, Public health

Background

Neck pain is a common problem in the working population [1, 2]. In particular, the prevalence of neck pain in office workers has been reported to be between 50 and 76 % in Australia and 45–63 % internationally [3–8]. Despite this, little is known about the consequences of this problem to the individual office worker and which strategies, if any, are utilized to ensure they remain at work [4]. Evidence suggests that neck pain may lead to care seeking behaviour, sickness absences and workers' compensation claims [4, 9, 10]. In Australia, neck pain account for a small proportion of all serious workers' compensation claims (2.2 %) [11], yet the contribution of persistent neck pain to the total burden of chronic pain in Australian society is 20 % [12]. Neck pain accounts for 20 % of the $34 billion each year spent on chronic pain in the Australian community [13]. Thus, gaining a greater understanding of how office workers manage their pain can enhance the development of validated and cost effective interventions and reduce the burden on the individual and the employer.

Current strategies utilized by office workers to remain at work with neck pain are unknown. Exploring the coping strategies office workers employ to manage their neck pain may provide some insight into the importance of this problem and help direct interventions in the workplace. A recent study of patients' experience and management of neck pain in general practice found that many self-managed their pain with techniques like massage and "over-the-counter medication" [14]. However, this study was conducted in Germany, which has a different health care system than Australia, where conservative interventions such as physiotherapy must be prescribed by a medical practitioner. Furthermore, it was not specifically conducted in a working population. The aims of this study were to 1) describe the consequences of neck pain for female office workers and 2) explore their self-reported management and coping strategies. It was hypothesised that female office workers with neck pain generally, do not submit worker's compensation claims but remain in the workforce by managing symptoms at the individual level by taking sick leave, visiting a health care professional and self-medication.

Methods

Study design

Data from eligible female office workers was obtained through a cross-sectional survey and clinical assessment. This research focused on neck pain in female office workers as females consistently demonstrate an increased prevalence of neck disorders and are usually over-represented in the office worker population [5, 15].

Participants

Office workers with neck pain over the age of 18 years and working at a computer more than 20 h per week were invited from 12 public and private institutions in the banking, local government and health industry sectors. A total of 333 office workers volunteered (overall response rate of 30 %) and were screened for eligibility based on the severity of neck complaints and history of neck trauma [3]. Those scoring greater than 8 % on the Neck Disability Index (NDI) and free of neck trauma were deemed as having neck complaints ($N = 174$, response rate 52.3 %). The score on the NDI was selected as the cut-off as this severity is indicative of mild to severe neck problems [16]. History of neck trauma was established by one question as previous musculoskeletal trauma of the neck, shoulder or arm has been shown to be a significant predictor of work absence [17]. The characteristics of all employees were established through an employee profile provided by each organization including age, gender, job titles, employment status, hours worked per week, and type of work performed. This profile did not differ between participants and non-participants.

Procedure

The comprehensive online survey collected demographic data and information about the consequences of their neck problem on their work and home activities, workplace psychosocial demands and physical ergonomic demands of their work [3]. The 174 eligible office workers were invited to attend a university clinic for further assessment of their neck pain of which 51 participants (29 %) agreed. To limit selection bias, no financial incentives or offers of treatment were provided. Figure 1 demonstrates the flow of participants in the study. The time lapse between survey and assessment was on average, 1 month. The assessment was undertaken during the worker's lunch time or after hours and consisted of an interview and physical examination performed by a qualified physiotherapist. The purpose of the interview was to further understand and describe the strategies used to manage their pain and consisted of questions about the severity and history of pain and the type of management sought. The physical examination consisted of manual palpation of the neck, assessment of active physiological movements of the neck and shoulders.

Ethical considerations

All participants were informed that participation was voluntary and that no remuneration or incentives would be provided by the investigators or their employer. Information on individual results was not released to the employer. Ethics for this study was granted by The University of Queensland Medical Ethics Committee (#2004000225).

Measures

Severity of neck pain

The NDI assessed the severity of disability due to neck pain [16] as this tool has been shown to have good test-retest reliability and internal consistency [18]. This index includes ten items that address functional activities including sleeping, reading, lifting, personal care, recreation, driving and work. There are six possible responses for each item which are scored from 0 (no disability) to 5 (complete disability). The final score is obtained as a percentage after adding the scores for each of the 10 items. A higher score indicates greater pain and disability.

Consequences of neck complaints

The Nordic Musculoskeletal Questionnaire (NMQ) was used to determine the duration of neck pain with the question "*What is the total length of time that you have had neck trouble (ache, pain or discomfort) during the last 12 months?*" [19] Five response options were possible from No days, 1–7days, 8–30days, >30 days but not every day, and every day. A body map was included to assist participants to understand the area defined as

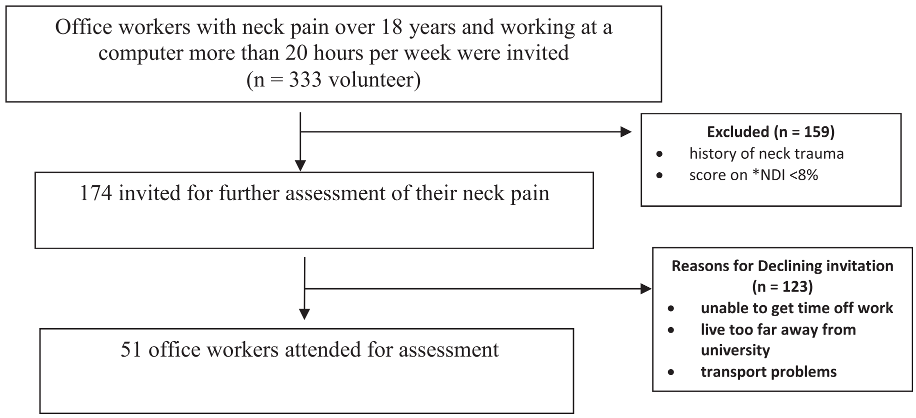

Fig. 1 Flow chart of participants through the study. **NDI* Neck Disability Index

the neck. This tool is widely used in occupational research [20] and is a validated and reliable tool [21].

Absence from work due to neck pain was assessed by one question from the NMQ: "*Have you been absent from work during the last 12 months because of trouble in the neck?"* This question showed high specificity and sensitivity when used to measure the occurrence of sickness absence due to back pain [22]. It has also been used in the assessment of sickness absence due to neck and upper extremity pain [23].

Health care use was determined by one question from the NMQ, *"Have you been seen by a doctor, physiotherapist, chiropractor or other health professional because of trouble in the neck during the last 12 months?"*. In the Australian health care system, workers do not require a medical referral to consult with allied health practitioners and may self-refer without the knowledge of the workplace or the worker's general practitioner.

Consequences on the workers' work activity, leisure activities, and submission of workers' compensation claims were evaluated with one question each with a dichotomous response option of No/Yes. These questions were from the NMQ [19]:

- *"Have you ever had to change jobs or duties because of neck trouble"*
- *"Has neck trouble caused you to reduce your activity at work during the last 12 months"*
- *"Has neck trouble caused you to reduce your leisure activity during the last 12 months?"*
- *"Have you ever been absent from work during the last 12 months because of neck trouble?"*
- *"Have you ever submitted a worker's compensation claim because of neck trouble?"*

The reliability of the NMQ to collect data on the prevalence and consequences of musculoskeletal pain has been established and shown to range from moderate to almost perfect [24]. The duration of time that neck pain affected work activity was evaluated with one question "*What is the total length of time that neck trouble has prevented you from doing your normal work (at home or away from home) during the last 12 months*?" with four response options: No days, 1–7 days, 8–30 days or greater than 30 days.

In the interview at the university clinic, participants were asked two-open ended questions: *'What do you think has caused your neck problems?'* and *'How do you manage your neck pain?'* The open ended questions were to reduce potential bias in responses. Responses to the first question were used to establish the work-relatedness of neck pain and were grouped into similar concepts with any ambiguity checked by another researcher.

The responses to the second question were used to determine the coping strategies adopted. Coping mechanisms refer to the specific thoughts and behaviours people use to manage their pain or their emotional reactions to their pain [25]. These self-management strategies were classified as either active or passive coping strategies based on the categorization tables of Brown and Nicassio [26]. Blyth et al. [27] subsequently used these groupings to examine the relationship between self-management strategies, disability and health care utilization in a population-based study of individuals with chronic pain. These authors identified passive coping strategies as any treatment where something was done to, or given to the patient. This was further divided into the two sub-categories of passive behavioural (e.g. massage, rest, heat) and conventional medical management strategies (e.g. medication, physiotherapy as these are given to or one to the patient). Active coping strategies were described as any instrumental activity initiated by the individual to manage their pain, if not characterised by avoidance or escape. For example, while rest may be initiated by the individual, it is considered a passive strategy as it is intended to escape from pain rather than to function despite the pain. These strategies were further divided into active behavioural with a physical component (e.g. exercise, postural modification) and cognitive (e.g. relaxation, mental distraction).

Analysis

Responses to the survey questions were analysed using descriptive statistical analyses to determine the percentage of positive and negative responses to each question about the impact of neck problems. SPSS version 22 (IBM Corporation New York, USA) was used to manage the data. Strategies to manage neck problems reported by the 51 participants were categorised as active (behavioural or cognitive) strategies or passive (behavioural or conventional medical) strategies. The percentage of participants nominating any of these four categories was calculated.

Results

In the last 12 months, 82 % of the office workers who volunteered reported experiencing neck pain. The mean score on the NDI of all 174 participants was 20.2 % (SD = 9.1) indicating mild neck pain and disability. The median age of participants was between 40 and 44 years. The mean age of the subsample of 51 participants was 44.3 years (SD = 9.5) with a mean NDI score of 22 % (SD = 8.9). This NDI score indicates that those who volunteered for further assessment were representative of the total sample population.

Survey results

Table 1 displays the reported consequences of neck pain in symptomatic female office workers. The results revealed that 20.7 % of participants who reported neck pain in the last 12 months were absent from work due to this pain. In addition, 14.9 % of workers did not participate in activities of daily living or normal work duties for 8 or more days in the last 12 months due to pain. Nearly a quarter of those surveyed indicated reducing their work activity due to neck pain but the impact on leisure activities was greater with 42 % affected. Only a small proportion of subjects reported changing jobs as a consequence of their neck pain. Advice and/or treatment from a health care professional was sought by 57.5 % of participants with only 5.2 % reported making a workers' compensation claim in relation to their neck pain.

Subsample results (*N* = 51)

Figure 2 displays the self-reported source of neck symptoms. The majority of participants believed performing computer work including keyboard work, mouse work and reading at computer was the source of their pain. Many participants indicated more than one source of pain.

Table 2 displays the active and passive self-management strategies utilised by the subgroup of female office workers to manage their neck pain. It can be seen that passive strategies were nominated more often than active self-management strategies. Conventional medical strategies were the most common strategies utilised. Use of prescription or over-the-counter medication (most commonly paracetamol and ibuprofen), physiotherapy, and visiting a medical practitioner were the most commonly reported management techniques used. Cognitive strategies were not employed at all by this population and exercise as an active behavioural strategy was only used by a

Table 1 Responses to survey questions on the consequences of neck pain (*N* = 174)

Survey question		Percent	(n)
Have you ever had to change jobs or duties because of neck trouble?	No	90.8 %	(158)
	Yes	9.2 %	(16)
Has neck trouble caused you to reduce your activity at work during the last 12 months?	No	77.6 %	(135)
	Yes	22.4 %	(39)
Has neck trouble caused you to reduce your leisure activity during the last 12 months?	No	58.0 %	(101)
	Yes	42.0 %	(73)
Have you ever been absent from work during the last 12 months because of neck trouble?	No	42.5 %	(74)
	Yes	57.5 %	(100)
What is the total length of time that neck trouble has prevented you from doing your normal work (at home or away from home) during the last 12 months?	0 days	54.6 %	(95)
	1-7days	30.5 %	(53)
	8-30days	8.6 %	(15)
	>30 days	6.3 %	(11)
Have you ever been absent from work during the last 12 months because of neck trouble?	No	79.3 %	(138)
	Yes	20.7 %	(36)
Have you ever submitted a worker's compensation claim because of neck trouble?	No	94.8 %	(165)
	Yes	5.2 %	(9)

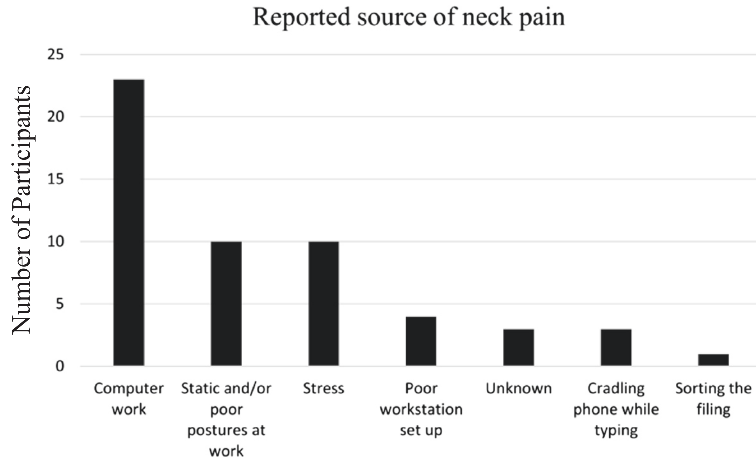

Fig. 2 Reported source of neck pain in 51 female office workers

small percentage of female office workers with neck pain. It is apparent that most participants employed more than one strategy to manage their symptoms.

Table 3 shows the categories and combination of self-management strategies used by female office workers with neck pain, the most common being the use of conventional medical management. Only five female office workers indicated not using anything to manage their pain and six used a combination of strategies.

Table 2 Self-management strategies used by female office workers with neck pain ($n = 51$)

Strategy used	Individuals reporting % (n)
Active Coping Strategies	
Behavioural:	
Exercise	5.88 % (3)
Stretches	1.96 % (1)
Posture Modification	1.96 % (1)
Cognitive:	
Mental Distraction, relaxation	0 % (0)
Passive Coping Strategies	
Behavioural:	
Massage	11.76 % (6)
Aromatherapy	1.96 % (1)
Conventional Medical:	
Medication	82.35 % (42)
Physiotherapy	64.71 % (33)
General Practitioner	54.90 % (28)
Chiropractor	19.61 % (10)
Medical Specialist	13.73 % (7)
Other health care practitioner	7.84 % (4)
Acupuncture	3.92 % (2)

Discussion

This study identified that the severity of neck pain in female office workers is mild but that it has negative impact on their work and leisure time activity. Approximately half of the sample reported that their participation in usual activities of daily living was reduced due to their neck pain. The number of workers compensations claims submitted was low with most participants using passive coping strategies to manage their pain and remain at work. The significant impact of neck pain on function has been highlighted by other researchers [4, 28, 29].

Nearly half of the participants nominated computer work or the ergonomic environment at work as the source of their neck pain. While there is ample evidence linking musculoskeletal symptoms of the neck with computer use or features of the ergonomic workstation [6, 30–32], causation cannot be inferred in this cross-sectional study. Prospective studies and systematic reviews offer mixed evidence for the relationship between

Table 3 Combinations of self-management strategies used by female office workers to manage their neck pain ($n = 51$)

Management combinations	Percent	(n)
Conventional medical only	70.59 %	(36)
No management	9.80 %	(5)
Passive behavioural & conventional medical	7.84 %	(4)
Active behavioural only	5.88 %	(3)
Passive behavioural only	3.92 %	(2)
Active behavioural, passive behavioural & conventional medical	1.96 %	(1)
Active behavioural & passive behavioural	0.00 %	(0)
Active behavioural & conventional medical	0.00 %	(0)
Cognitive only	0.00 %	(0)

the ergonomic environment and incident neck pain. Côté et al. [33] found that poor computer workstation design and work posture were two of several factors associated with the development of an episode of neck pain. In contrast, another systematic review found strong evidence that high keyboard usage time and poor perception of computer placement have no predictive value for the onset of neck pain [34].

It is interesting to note that 22.4 % of the participants identified that their work activity had decreased. This is similar to two previous studies which also identified self-perceived reductions in productivity at work due to neck problems of 26 % in the Netherlands [35] and 13 % in Sweden [36]. Our study is the first in Australia to suggest the possibility of reduced productivity due to neck problems in office workers. This is an important finding as it suggests that "presenteeism" may be a concern in the workplace. Presenteeism has been defined as the decrease in performance associated with a worker remaining at work whilst impaired by a health condition [37]. Although challenging to measure, it has been estimated that presenteeism can result in up to four times greater loss in productivity than absenteeism [37, 38]. Thus, the cost of presenteeism for the workplace may be greater than direct health care costs [39, 40]. Our study suggests that this may be occurring in office workers with neck pain and requires further investigation.

The sub-sample of office workers used a range of self-management strategies, mostly passive in nature. This is consistent with findings in other neck pain related studies [41]. Passive coping strategies were reported more often than active strategies in our sub-sample of female office workers and usually consisted of over the counter or prescription medications, physiotherapy and/or consultation with a general practitioner.

It is surprising that exercise was reported by so few participants as a strategy to manage neck pain. Two systematic reviews have found strong evidence to support the positive effect of muscle strengthening and endurance exercises for controlling neck pain in office workers [42, 43]. When combined with manual therapy, these interventions, which consist of both passive and active strategies, produce greater improvements in pain, function, quality of life and patient satisfaction compared to manipulation or mobilisation alone for chronic neck pain [44]. Health practitioners are encouraged to recommend such interventions for office workers with neck pain.

There is evidence that the use of active self-management strategies can substantially reduce the likelihood of developing disabling pain [27, 45, 46]. Conversely, the use of passive coping strategies has been associated with an increased risk of developing disabling trouble or pain related disability [35, 45, 47]. Carroll et al. [41] identified that high use of passive coping strategies to manage neck or lower back pain can lead to the inability to work or carry out usual activities of daily living. This is reflected in our study, where passive coping strategies were mainly used, and could explain why neck pain had a significant impact on leisure activities, activities of daily living and work activity. Hence, it would be useful for clinicians to include education on active self-management strategies for neck pain. Recently, active self-management strategies have been shown to be more effective than passive physiotherapy techniques by increasing self-efficacy [46].

In our sample, only a small proportion submitted a workers' compensation claim for their neck pain supporting our primary hypothesis. There are several reasons for the lack of claims submitted for neck problems in the working population. Firstly, neck pain is common in the general population [48] thus it would be difficult to establish the relative contribution of work. Secondly, the neck pain may be effectively managed with conservative treatments and of insufficient severity and duration to warrant the trouble of submitting a claim.

Study limitations

The conclusions drawn from this study need to be considered in light of several limitations. The findings of this study cannot be generalised beyond female office workers. This sample may not be a true representation of office workers as many potential participants may have already left the workplace or sought alternate employment due to neck pain. As only 29 % of the study sample agreed to attend for further assessment of their neck pain, it is possible that selection bias contributed to the interview findings of the 51 office workers with only those with significant pain attending. Thus the results of this research cannot be generalized to all female office workers with neck pain. However, the level of neck pain and disability of this subsample did not differ from the sample population suggesting their responses were representative of the larger sample of office workers. While a strength of this study was the use of validated tools to measure health outcomes, they were based on self-reports rather than objective measures. This has been linked with both over and under estimation of prevalence of health outcomes [49, 50]. It is possible that measurement error was introduced due to common method bias or information bias (e.g. item characteristics or context), however the magnitude is thought to be small [51]. Attempts were made to limit method bias. For example, during the interview, the researcher used open-ended questions to determine participant's perception of the source of their neck pain or the strategies used to manage it. Self-report measures of work absence and workers' compensation data were not validated with employee records due to lack of access to these databases. However, the use of questionnaires to establish rates of sickness absences is considered a valuable source of information correlating relatively well with company records [52]. Despite the limitations identified, the findings of this research provide insight into the self-reported impact on neck pain in a working population of female office workers.

Conclusion

This study has important implications for the workplace and health professionals. Although the severity of neck pain in this sample of female office workers is low, the impact on work is of concern. This study suggests the level of presenteeism in the female office workers may be significant, with many self-managing by reducing work and/or leisure activity and utilizing passive coping strategies. Future research should investigate the benefits of active coping strategies for office workers with neck problems to the individual and employer. Physiotherapists are well placed to assist office workers self-manage their symptoms to ensure they remain healthy at work.

Abbreviations

NDI, neck disability index; NMQ, nordic musculoskeletal questionnaire

Effect of Training Supervision on Effectiveness of Strength Training for Reducing Neck/Shoulder Pain and Headache in Office Workers: Cluster Randomized Controlled Trial

Objective. To investigate the effect of workplace neck/shoulder strength training with and without regular supervision on neck/shoulder pain and headache among office workers. *Method.* A 20-week cluster randomized controlled trial among 351 office workers was randomized into three groups: two training groups with the same total amount of planned exercises three times per week (1) with supervision (3WS) throughout the intervention period, (2) with minimal supervision (3MS) only initially, and (3) a reference group (REF). Main outcome is self-reported pain intensity in neck and shoulder (scale 0–9) and headache (scale 0–10). *Results.* Intention-to-treat analyses showed a significant decrease in neck pain intensity the last 7 days in 3MS compared with REF: -0.5 ± 0.2 ($P < 0.02$) and a tendency for 3WS versus REF: -0.4 ± 0.2 ($P < 0.07$). Intensity of headache the last month decreased in both training groups: 3WS versus REF: -1.1 ± 0.2 ($P < 0.001$) and 3MS versus REF: -1.1 ± 0.2 ($P < 0.001$). Additionally, days of headache decreased 1.0 ± 0.5 in 3WS and 1.3 ± 0.5 in 3MS versus REF. There were no differences between the two training groups for any of the variables. *Conclusion.* Neck/shoulder training at the workplace reduced neck pain and headache among office workers independently of the extent of supervision. This finding has important practical implications for future workplace interventions.

1. Introduction

Work-related symptoms in neck and shoulder are common among occupational computer users and other sedentary occupations [1, 2] although the evidence of causality is inconclusive [3, 4]. Along with pain in the neck and shoulders, office work is associated with frequent headache and cooccurrence of headache is estimated to be fourfold in workers with musculoskeletal symptoms [5]. Neck pain and headaches are closely related too, although the reported headaches only are rarely diagnosed further into tension-type headache or migraine [6].

Additionally, studies have shown a 31% decrease in quality of life among workers with neck/shoulder symptoms [7] and self-reported health is inversely correlated with neck/shoulder pain [8] and headache [9, 10]. Thus, there is a need for initiatives to reduce the pain problem among office workers who are exposed to repetitive low intensity musculoskeletal load in the neck and shoulder region.

In the past decade, exercise interventions at the workplace have become more common and studies have shown positive effect of physical exercise at work in managing musculoskeletal pain [11–13]. Especially neck pain seems to respond positively to specific strength training, while evidence of strength training impact on shoulder pain is sparse [11–17]. Furthermore, exercise interventions at the workplace have shown significant reduction headache intensity [18] and headache frequency [19].

Exercise programs with supervision are most likely to be beneficial in reducing pain among patients with low back pain [20]. Likewise weekly supervision in maintenance training had significantly better effect than unsupervised training [21], and the effect was closely related to adherence to the program. In a systematic review Coury et al. [12] concluded that there was indication for strong evidence of ineffectiveness for unsupervised training. Exercise programs supervised by instructors enable the participants regularly to tailor the program to the instructions which may have a physiological and motivational value that the unsupervised participants do not benefit from. On the other hand some participants do prefer—after being introduced to the program—to exercise when it fits into their daily routines.

When conducting workplace interventions one may presume that the use of supervision is important to maximize training effects and compliance. Studies that make use of supervision report positive impact on neck/shoulder pain [11, 12, 14–17]; however, the specific effect of the supervision on pain relief is not well established [22]. A study conducting exercise intervention at the workplace showed that only with a single introductory session of supervision a significant reduction of neck/shoulder pain intensity in office workers was attained [23]. However, the study was uncontrolled and did not compare supervised exercises with unsupervised exercises. Supervised training can be expensive and not always an available resource at workplaces. Therefore it is pertinent to reveal the minimum amount of supervision needed for safe and effective exercise training for pain reduction when implementing exercise at the workplaces.

This study is part of a larger intervention program: Workplace adjusted intelligent physical exercise training for reducing musculoskeletal pain in shoulder/neck (VIMS) [24] and investigates the effect of instructor supervised versus minimally supervised exercise training on neck/shoulder pain. The concept of "intelligent physical exercise training" is to balance the individual physiological capacity relatively to occupational exposure, tailor the exercise to individual capacities and disorders, allow for flexibility and personal preferences of the participant, and to be as cost effective for the company as possible.

The aim of this paper is to investigate the relevance of training supervision for safe and effective training, in order to minimize expenses for workplace physical exercise training.

The hypotheses are as follows.

(1) Both training interventions have positive effects on neck/shoulder pain and headache compared with reference.

(2) Regular supervision of the exercise training will result in a larger effect compared with initial instruction only.

(3) Regular supervision of the exercise will have a positive influence on compliance compared with minimal supervision.

2. Methods

2.1. Study Design. The study was a cluster randomized controlled trial and the intervention period was 20 weeks. The participants were office workers of a national public administrative authority recruited from 12 geographically different units that were located in major cities throughout Denmark.

Randomization was performed on a cluster level to minimize contamination between the participants; for details see Andersen et al. [24]. In short, the clusters were naturally occurring groups of employees working together on a daily basis, being located at the same floor, same office or the like. To ensure the comparability of the training groups and the reference group, the geographical sites were categorized into 13 strata [24]. Adjustments were made in respect to the cluster allocation due to 26 participants being relocated to other work sites between the time of randomization and the start-up of the different interventions (approx. 3 weeks) in order to have these participants follow the intervention for the cluster of their new colleagues. No subsequent reallocations were performed. The participants were randomized into five groups: one reference group (REF) without exercise training and four training groups performing specific strength training. The present study addressed only two of these training groups: one was scheduled for training 3 × 20 minutes per week with supervising half of the sessions throughout the training period (3WS) and the other group was likewise scheduled for training 3 times per week but only received minimal supervision (3MS), which was given initially in terms of instructions for 2 sessions to learn the exercises correctly. The total number of planned training was 60 sessions (3 × 20 weeks) of which 3WS had instructors supervising the training 10 hours (30 sessions × 20 min), while 3MS had instructor supervision for 40–60 min (due to absence by some participants instructors would usually have to come for 2-3 training sessions for this group). A previous paper addresses the other training groups [14].

Written informed consent was obtained from all participants before they entered the study.

The study protocol was approved by the local ethics committee (H-C-2008-103) and registered in ClinicalTrials.gov (no. NCT01027390).

2.2. Participants. About half of the participants were recruited from the Capital Region and the other half from other parts of Denmark. Thereby the population is nationally representative and strengths external validity. The eligibility criterion was employees performing office work for at least half of their working hours. The exclusion criteria were (i) hypertension (systolic BP > 160, diastolic BP > 100) or cardiovascular diseases, (ii) symptomatic herniated disc or severe disorders of the cervical spine, (iii) postoperative conditions in the neck or shoulder region, (iv) history of severe trauma, (v) pregnancy, (vi) or serious disease.

2.3. Intervention. The two training groups had the same total amount of exercises and repetitions planned three times per week. The training groups performed specific strength training with 4 different dumbbell exercises for the neck and shoulder muscles and one for the wrist as described in detail previously [24]: front raise, lateral raise, reverse flies, and shrugs.

The participants performed warm-up exercises in the beginning of each training session (10 repetition of each exercise with 50% of 1 repetition maximum (RM)). At the beginning and halfway through the intervention period, the participants were tested for optimizing the training intensity and the loads were progressively increased according to the principle of periodization and progressive overload [25]. The intensity of the program increased gradually from 20 RM at the beginning of the intervention period to 8 RM further along in the process.

2.4. Outcome Measures. Structured e-mail based questionnaires were applied before and after the intervention. The primary outcome was musculoskeletal pain symptoms in neck/shoulder and secondary outcome was headache characteristics [24].

The standardized nordic questionnaire [26] was applied at baseline before the randomization and repeated after the intervention. The questions were "How many days have you had trouble in body part during the last three months?" (0 days; 1–7 days; 8–30 days; >30 days; everyday) for symptom duration, and "On average, how intense was your pain in body part during the last three months on a scale ranging from 0 to 9?" where 0 is no pain and 9 is worst imaginable pain for symptom intensity. The same question was also asked for pain during the previous seven days.

Secondary outcome variables were headache characteristics (frequency and pain intensity).

Question about duration of headache was "How many days have you had a headache during the previous month?" The following response options were 0, 1–3, 4–7, 8–14, and >14 days. For subsequent analyses 1–3 days were recorded to 2 days, 4–7 days to 5.5 days, 8–14 to 11 days, and >14 to 20 days. Intensity of headache was also inquired about "On average, how bad were your headaches when you experienced them during the previous month?" where 0 is no pain and 10 is worst imaginable pain [19].

Compliance was based on follow-up questionnaire replies on training frequency (completers).

The response categories were (1) "regular exercise training 40–60 min/week," (2) "regular exercise training 20–40 min/week," (3) "not regular but at least 80 min/month," and (4) "not regular but at least 40–60 min/month." Regular training was collapsed into "regular exercise training 20–60 min per week."

2.5. Statistical Analyses. The statistical analyses were based on an intention-to-treat approach (ITT) via Stata SE12 (StataCorp LP, College Station, Texas). Missing values in postmeasurements were substituted with the last observation carried forward [27, 28]. Differences between groups in neck/shoulder pain and headache frequency and intensity were tested using analyses of covariance (ANCOVA) with the level at baseline and sex as a covariate.

In addition to the ITT analyses we performed analyses using ANCOVA only on completers, defined as those who had answered the questionnaire before and after the intervention and the rest were defined as noncompleters. Relationship between neck pain and headache was estimated using Spearman rank correlation. We also defined a subgroup, neck-pain cases, as those who at baseline reported pain intensity in the neck during the last 3 months of 3 or more (scale 0–9) [29]. This sub group analysis was performed on ITT data as well as completers only.

Results were considered statistically significant if the 2-tailed P value was ≤ 0.05.

3. Results

3.1. Baseline. Flow of participants through the trial is presented in Figure 1. The present study included 351 participants cluster randomized in 3 groups: 3WS ($n = 126$), 3MS ($n = 124$), and REF ($n = 101$). At baseline there were no significant differences between the groups (Table 1).

Baseline data on demographics and pain variables for the entire study group is presented in Table 1 and for completers and neck-pain cases in Table 2. Analyses on completers ($n = 220$) versus noncompleters ($n = 131$) showed no significant differences between these groups at baseline on pain variables. However, noncompleters were significantly younger than completers; mean age 44 ± 1.4 versus 47 ± 0.7 ($P < 0.05$).

Four participants reported nonpermanent injuries during the intervention period: back pain ($n = 2$), shoulder/wrist pain ($n = 1$), and pain in the knee ($n = 1$).

Mean values on neck pain were ~3 on a scale 0–9 (Table 1) and neck-pain cases accounted for 56% (pain intensity 3 or more the last 3 months). Of note is further that relatively many participants reported pain intensity corresponding to 4 or more: 41% (the last 3 months) and 32% (the last 7 days).

Regarding headache, approximately 15% of the participants reported having headache above 7 days the previous month with an average intensity at 7.0 ± 1.9. Average number of days in which participants used medication because of headache was for WS: 2.3 ± 1.0, MS: 2.2 ± 1.0, and REF: 2.4 ± 0.9.

Among neck-pain cases ($n = 197$), 90% also reported headache; mean headache frequency at baseline is 6.5 ± 5.9 days of previous month.

A statistical significant relationship between intensity of neck pain the last three months and intensity of headache during the previous month was identified (Spearman correlation, r: 0.39 ($P < 0.001$)).

3.2. Intervention

3.2.1. Primary Outcome

Neck and Shoulder Pain (ITT analyses). Intention-to-treat analyses showed a significant decrease in neck pain intensity the last 7 days in 3MS compared with REF: −0.5 ± 0.2 ($P < 0.02$) and a tendency for 3WS versus REF: −0.4 ± 0.2 ($P < 0.07$) (Table 3). Analyses on neck pain the last 3 months and shoulder pain did not show any significant changes (Table 3).

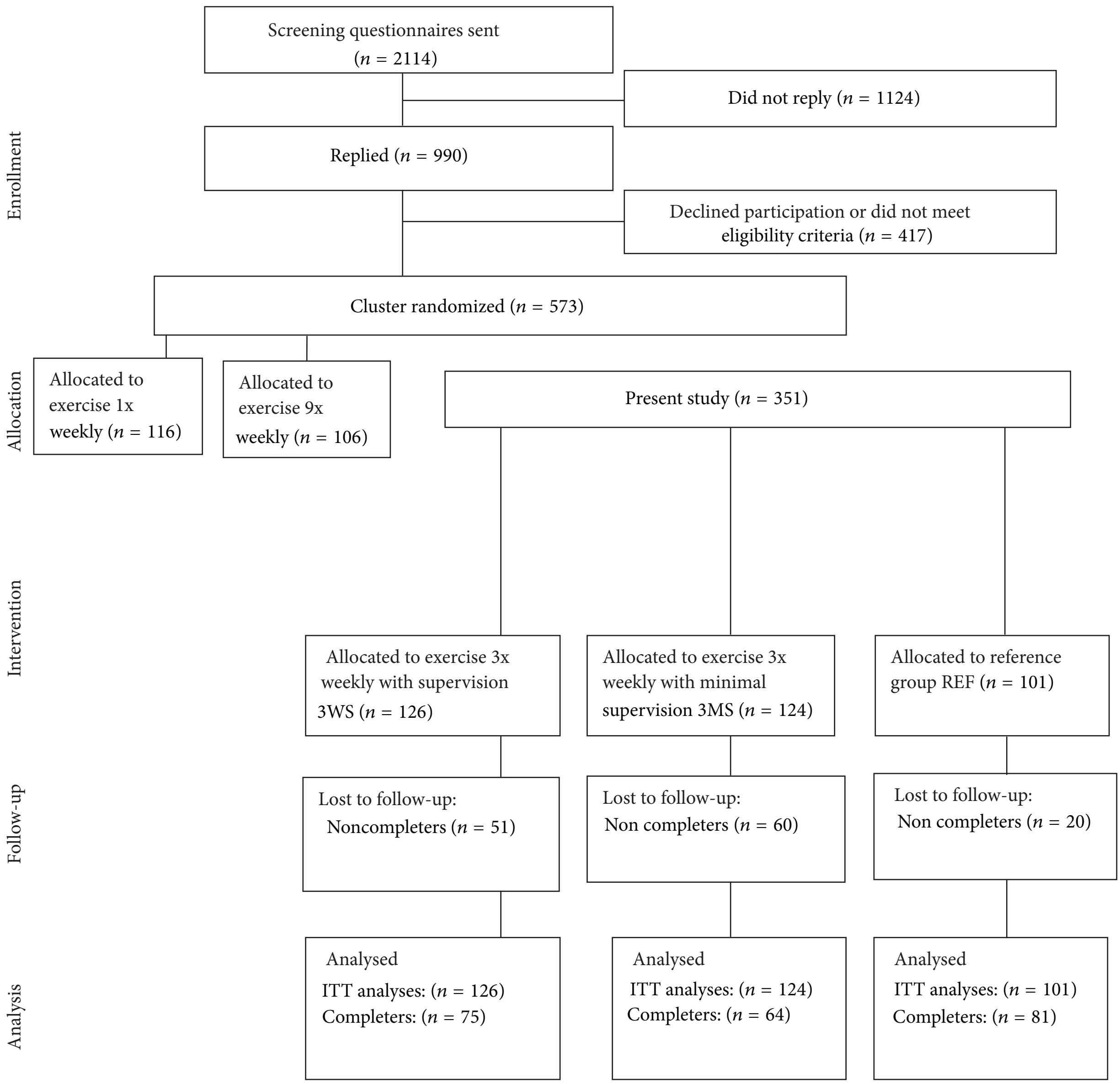

Figure 1: Flowchart of the trial.

ITT-analyses for the group defined as neck-pain cases (n = 197) showed a significant decrease in neck pain the last 7 days, 3WS versus REF: −0.7 ± 0.4 ($P < 0.05$) but not for 3MS versus REF. Similarly, analyses on neck pain over the last 3 months showed significant decrease in neck pain only in 3WS versus REF: −0.7 ± 0.4 ($P = 0.05$). There were no significant changes in shoulder pain within the group of neck-pain cases.

Neck and Shoulder Pain (completers). In both training groups there were significant decreases in the intensity of neck pain (last 3 months): 3WS versus REF: −1.0 ± 0.3 ($P < 0.001$) and 3MS versus REF: −0.9 ± 0.3 ($P < 0.001$) (Table 4). Additionally, both groups showed a significant decrease in the intensity of neck pain (7 days): 3WS versus REF: −1.0 ± 0.3 ($P < 0.001$) and 3MS versus REF: −1.1 ± 0.3 ($P < 0.001$). The same applied to the intensity of shoulder pain the last 3 months in both training groups: 3WS versus REF: −0.7 ± 0.3 ($P < 0.01$) and 3MS versus REF: −0.6 ± 0.3 ($P < 0.05$). There were no significant changes in the intensity of shoulder pain the last 7 days (Table 4).

At baseline, completers defined as neck-pain cases (n = 124) had intensity of neck pain (last 3 months) corresponding to 5.1±1.6 (3WS), 5.2 ± 2.0 (3MS), and 4.1±2.1 (REF). Further censored analyses on this sub-group showed significant changes in the intensity of neck pain the last 3 months for both training groups compared to REF: 3WS: −1.9 ± 0.4 ($P <$ 0.001) and 3MS: −1.1 ± 0.5 ($P < 0.03$) as well as in intensity of neck pain the past 7 days: 3WS: −1.7 ± 0.5 ($P < 0.001$) and 3MS: −1.4 ± 0.5 ($P < 0.004$) (Table 5). Furthermore, among completers defined as neck-pain cases there was a significant difference between 3WS and 3MS in intensity of neck pain (last 3 months) with better improvement in 3WS; 0.8 ± 0.4

Table 1: Baseline demographic and clinical characteristics of trial groups.

Characteristics	Exercise group 3WS (n = 126)	Exercise group 3MS (n = 124)	Reference group (n = 101)	Min–Max (n = 351)	P
Sex, (m/f)	39/87	52/72	42/59		NS
Age, (y)	46 ± 10	45 ± 11	46 ± 10	22–66	NS
BMI	24.7 ± 4.3	25.6 ± 3.8	26.0 ± 4.5	14–45	NS
Pain (on scale 0–9)					
Neck pain (3 months)	3.1 ± 2.4	3.2 ± 2.4	3.2 ± 2.3	0–9	NS
Neck pain (7 days)	2.6 ± 2.5	2.4 ± 2.4	2.5 ± 2.5	0–9	NS
Right shoulder pain (3 months)	2.3 ± 2.4	2.0 ± 2.4	2.0 ± 2.4	0–8	NS
Right shoulder pain (7 days)	1.8 ± 2.3	1.6 ± 2.2	1.6 ± 2.3	0–8	NS
Left shoulder pain (3 months)	1.8 ± 2.3	1.6 ± 2.3	1.5 ± 1.9	0–9	NS
Left shoulder pain (7 days)	1.4 ± 2.0	1.3 ± 2.0	1.3 ± 1.9	0–8	NS
Headache (pain scale 0–10)	3.4 ± 2.5	3.6 ± 2.8	3.6 ± 3.0	1–10 (n = 211)	NS
Headache (days of last month)	3.8 ± 4.3	4.1 ± 4.7	4.2 ± 4.9	0–>14 days	NS

Values are mean (SD) and numbers. P values for the 1-way analysis of variances.

Table 2: Baseline neck pain, right shoulder pain, and headache in completers and neck-pain cases, respectively.

Characteristics	Exercise group 3WS		Exercise group 3MS		Reference group		P
	Completers (n = 75)	Neck-pain cases (n = 69)	Completers (n = 64)	Neck-pain cases (n = 70)	Completers (n = 81)	Neck-pain cases (n = 58)	
Completers (neck-pain cases)							
Neck pain (3 months)	3.0 ± 2.5	5.0 ± 1.6	3.5 ± 2.5	4.9 ± 1.7	3.4 ± 2.3	4.8 ± 1.6	NS
Neck pain (7 days)	2.4 ± 2.5	4.2 ± 2.1	2.5 ± 2.4	3.8 ± 2.3	2.7 ± 2.5	3.9 ± 2.2	NS
Right shoulder pain (3 months)	1.8 ± 2.2	3.3 ± 2.4	2.1 ± 2.4	2.7 ± 2.6	1.9 ± 2.4	3.2 ± 2.5	NS
Right shoulder pain (7 days)	1.3 ± 1.9	2.8 ± 2.5	1.5 ± 2.2	2.2 ± 2.4	1.6 ± 2.3	2.7 ± 2.6	NS
Left shoulder pain (3 months)	1.4 ± 2.0	2.8 ± 2.5	1.8 ± 2.4	2.2 ± 2.3	1.6 ± 2.0	2.2 ± 2.2	NS
Left shoulder pain (7 days)	1.0 ± 1.7	2.2 ± 2.3	1.4 ± 2.1	2.0 ± 2.3	1.5 ± 2.1	2.0 ± 2.2	NS
Headache (pain scale 0–10)	4.9 ± 1.8	5.5 ± 2.0	5.5 ± 2.8	6.1 ± 2.4	5.7 ± 2.5	6.4 ± 2.5	NS
Headache (days last month)	2.2 ± 1.0	2.6 ± 1.1	2.5 ± 2.8	2.8 ± 1.2	4.4 ± 1.1	2.8 ± 1.2	NS

Values are mean (SD) and numbers. P values for the 1-way analysis of variances. Completers had answered the questionnaire before and after the intervention. Neck-pain cases reported pain intensity in neck last 3 months of 3 or more at baseline (scale ranging from 0 to 9).

($P = 0.05$). Concerning shoulder pain within this sub-group there was a significant decrease in intensity of shoulder pain the last 3 months in the 3WS group compared to the reference group: −1.2 ± 0.4 ($P < 0.003$) (right shoulder) and −0.8 ± 0.4 ($P < 0.03$) (left shoulder) but not in the 3MS group (Table 5). There were no significant changes in intensity of shoulder pain the last 7 days, neither in 3WS nor in 3MS.

3.2.2. Secondary Outcome

Headache (ITT analyses). Results of secondary outcome variables are shown in Table 3. There was a significant reduction in days with headache in both training groups compared to the reference group. Furthermore, there was a significant decrease in pain intensity in both training groups compared to the reference group. In the group of neck-pain cases there was a significant decrease in headache intensity in 3WS versus REF: −0.9 ± 0.4 ($P < 0.02$) and 3MS versus REF: −0.9 ± 0.3 ($P < 0.01$).

After the intervention, there were no changes in the use of medication because of headache.

Headache (completers). Days with headache last month decreased significantly in both groups compared to the reference group: 3WS versus REF: −0.6 ± 0 ($P < 0.001$) and 3MS versus REF: −0.6 ± 0.1 ($P < 0.001$), and the pain intensity decreased significantly in both training groups compared to the reference group: 3WS versus REF: −1.6 ± 0.4 ($P < 0.00$) 1 and 3MS versus REF: −1.5 ± 0.3 ($P < 0.001$) (Table 4).

Compliance. Among completers 60% in the 3WS group and 47% in the 3MS group reported that they were exercising on a regular basis 20–60 min a week in the intervention period. There was no significant difference in compliance between the groups ($P < 0.14$) with an overall value of 54% participating at a regular basis.

Regarding primary and secondary outcomes, the analyses on the entire group showed no significant difference between the two training groups.

4. Discussion

The major findings of this study were significant reductions of similar magnitude in neck/shoulder pain and in headache

Table 3: Summary results for each study group after 20 weeks of intervention (ITT data).

Characteristics	3WS Post-pre (SD) (n = 126)	3MS Post-pre (SD) (n = 124)	Ref. group Post-pre (SD) (n = 101)	Difference 3WS versus REF (95% CI) (SE)	P	Difference 3MS versus REF (95% CI) (SE)	P
Pain (a scale ranging from 0 to 9)							
Neck pain (3 months)	−0.9 ± 2.1	−0.9 ± 1.5	−0.6 ± 2.0	−0.4 ± 0.2 (−0.8 to 0.1)	0.11	−0.3 ± 0.2 (−0.7 to 0.1)	0.15
Neck pain (7 days)	−0.7 ± 2.1	−0.6 ± 1.5	−0.2 ± 2.0	−0.4 ± 0.2 (−0.9 to 0.03)	0.07	−0.5 ± 0.2 (−0.9 to −0.1)	0.02*
Right shoulder pain (3 months)	−0.5 ± 1.9	−0.5 ± 2.0	−0.2 ± 1.9	−0.1 ± 0.2 (−0.6 to 0.3)	0.50	−0.3 ± 0.2 (−0.8 to 0.1)	0.13
Right shoulder pain (7 days)	−0.3 ± 1.8	−0.4 ± 1.8	−0.2 ± 1.9	0.0 ± 0.2 (−0.4 to 0.4)	0.97	−0.2 ± 0.2 (−0.6 to 0.3)	0.43
Left shoulder pain (3 months)	−0.4 ± 1.5	−0.5 ± 1.5	−0.3 ± 1.8	0.0 ± 0.2 (−0.4 to 0.4)	0.99	−0.2 ± 0.2 (−0.5 to 0.2)	0.46
Left shoulder pain (7 days)	−0.8 ± 1.6	−0.3 ± 1.4	−0.4 ± 1.8	0.3 ± 0.2 (−0.1 to 0.7)	0.19	0.1 ± 0.2 (−0.3 to 0.4)	0.77
Headache (pain scale, 0–10)	−0.4 ± 1.8	−0.4 ± 1.4	0.7 ± 2.2	−1.1 ± 0.2 (−1.6 to −0.6)	0.00*	−1.1 ± 0.2 (−1.5 to −0.6)	0.00*
Headache (days of last month)	−0.4 ± 3.7	−0.7 ± 2.6	0.6 ± 4.4	−1.1 ± 0.5 (−2.1 to −0.1)	0.03*	−1.3 ± 0.5 (−2.2 to −0.5)	0.00*

Changes in post-pre values are absolute and not adjusted. Differences are estimated as the difference between means, with 95% confidence intervals, based on the 1-factor analyses of covariance with the level at baseline and sex as a covariate. *Significant change.

Table 4: Summary results for each study group after 20 weeks of intervention (completers).

Characteristics	3WS: post-pre (SD) (n)	3MS: post-pre (SD) (n)	Ref.: post-pre (SD) (n)	Difference 3WS versus REF (95% CI) (SE)	P	Difference 3MS versus REF (95% CI) (SE)	P
Neck pain (3 months)	−1.5 ± 2.5 (75)	−1.8 ± 1.7 (64)	−0.7 ± 2.2 (81)	−1.0 ± 0.3 (−1.5 to −0.4)	0.00*	−0.9 ± 0.3 (−1.5 to −0.4)	0.00*
Neck pain (7 days)	−1.1 ± 2.6 (75)	−1.2 ± 1.9 (64)	−0.2 ± 2.2 (81)	−1.0 ± 0.3 (−1.6 to −0.4)	0.00*	−1.1 ± 0.3 (−1.6 to −0.5)	0.00*
Right shoulder pain (3 months)	−0.8 ± 2.4 (75)	−1.0 ± 2.7 (64)	−0.2 ± 2.1 (81)	−0.7 ± 0.3 (−1.2 to −0.2)	0.01*	−0.6 ± 0.3 (−1.2 to 0.0)	0.04*
Right shoulder pain (7 days)	−0.5 ± 2.3 (75)	−0.7 ± 2.5 (64)	−0.2 ± 2.1 (81)	−0.5 ± 0.3 (−1.0 to 0.0)	0.07	−0.5 ± 0.3 (−1.1 to 0.1)	0.09
Left shoulder pain (3 months)	−0.7 ± 1.9 (75)	−0.9 ± 2.0 (64)	−0.4 ± 2.0 (81)	−0.0 ± 0.2 (−0.5 to 0.4)	0.89	0.4 ± 0.2 (−0.1 to 0.9)	0.10
Left shoulder pain (7 days)	−0.3 ± 2.1 (75)	−0.6 ± 1.9 (64)	−0.5 ± 2.0 (81)	−0.2 ± 0.3 (−0.7 to 0.4)	0.59	0.0 ± 0.3 (−0.5 to 0.6)	0.90
Headache (pain scale 0–10)	−2.0 ± 2.2 (58)	−2.1 ± 1.6 (55)	−0.7 ± 2.2 (64)	−1.6 ± 0.4 (−2.4 to −0.8)	0.00*	−1.5 ± 0.3 (−2.2 to −0.9)	0.00*
Headache (days of last month)	−0.6 ± 4.9 (75)	−1.4 ± 3.6 (64)	−0.7 ± 4.9 (81)	−1.9 ± 0.7 (−3.3 to −0.5)	0.01*	−2.2 ± 0.6 (−3.4 to −1.0)	0.00*

Changes in post-pre values are absolute and not adjusted. Values are means with standard deviation presented for each group (completers). Differences are estimated as the difference between means (SE), with 95% confidence intervals, based on the 1-factor analyses of covariance with the level at baseline and sex as a covariate. *Significant change.

for 3WS and 3MS compared to REF after a 20-week training period. Furthermore, the training program was considered to be safe since only 4 out of 351 participants (1%) reported transitory adverse events of short duration.

Our study hypothesis was that training with supervision would be more effective on neck/shoulder pain as well as headache reduction and that the supervision would cause better compliance than training without supervision. The study could not confirm this hypothesis since the sizes of these effects of pain reduction among the intervention groups were of the same order of magnitude. By and large, the relative difference between baseline and postmeasurements was 10–20% for neck pain and ~30% for headache intensity for both training groups in the ITT analyses when compared to REF. Similarly, the relative difference was ~30–40% for neck pain and ~30% for headache intensity among completers. In the

Table 5: Summary results for each neck-pain cases group after 20 weeks of intervention (completers only).

Characteristics	3WS: post-pre (SD) ($n = 39$)	3MS: post-pre (SD) ($n = 37$)	Ref.: post-pre (SD) ($n = 48$)	Difference 3WS versus REF (95% CI) (SE)	P	Difference 3MS versus REF (95% CI) (SE)	P
Neck pain (3 months)	−3.1 ± 2.2	−2.4 ± 1.9	−1.2 ± 2.6	−1.9 ± 0.4	0.000*	−1.1 ± 0.5	0.022*
Neck pain (7 days)	−2.4 ± 2.7	−1.8 ± 2.1	−0.6 ± 2.5	−1.7 ± 0.5	0.000*	−1.4 ± 0.5	0.003*
Right shoulder pain (3 months)	−1.7 ± 2.5	−1.3 ± 3.2	−0.7 ± 2.4	−1.1 ± 0.4	0.002*	−0.8 ± 0.5	0.096
Right shoulder pain (7 days)	−1.2 ± 2.8	−0.9 ± 2.9	−0.7 ± 2.5	−0.8 ± 0.4	0.062	−0.7 ± 0.5	0.170
Left shoulder pain (3 months)	−1.4 ± 2.2	−1.4 ± 2.2	−0.6 ± 2.2	−0.8 ± 0.4	0.024*	−0.6 ± 0.4	0.156
Left shoulder pain (7 days)	−0.8 ± 2.6	−1.0 ± 2.3	−0.9 ± 2.4	−0.2 ± 0.4	0.634	−0.2 ± 0.4	0.727
Headache (pain scale 0–10)	−0.5 ± 2.8	−0.9 ± 1.5	0.5 ± 2.5	−1.4 ± 0.5	0.008*	−1.3 ± 0.4	0.001*
Headache (days of last month)	−0.9 ± 4.7	−1.4 ± 3.1	0.9 ± 4.6	−2.3 ± 0.9	0.010*	−2.1 ± 0.8	0.006*

Changes in post-pre values are absolute and not adjusted. Values are means with standard deviation presented for each group (neck-pain and completers). Differences are estimated as the difference between means (SE), with 95% confidence intervals, based on the 1-factor analyses of covariance with the level at baseline and sex as a covariate. *Significant change.

group of pain cases the relative difference was 16–8% for headache intensity.

The results showed relatively high intensity of neck pain since approx. 40% of the participants reported neck pain corresponding to 3 or above 3 on a scale 1–10. Furthermore, relatively high frequency of days with headache was reported at baseline.

Reduction of neck pain associated with work site intervention program in this study is consistent with results from previous studies [11–15] and confirms also the positive effect of exercise training to reduce headache [17, 18, 30]. In this study, the headache could not be further classified or quantified into tension-type headache or migraine, as it required a detailed diagnostic interview and a neurological examination plus a prospective diagnostic diary which is quite time consuming and complicated to be applied in large scale working place studies like the present.

It is highly relevant to investigate the importance of training supervision when conducting exercise training at the workplace because recruitment of training instructors is elaborative and expensive and may result in restriction of training times. Training supervision as used in present study requires an annual basis salary of approx. 78 hours for instructors. This may hinder implementation of exercise training programs during working hours. Based on the scientific literature the effect of supervision shows conflicting findings. Zavanela et al. [31] showed decreased neck/shoulder pain and headache of bus drivers after 24 weeks of supervised training intervention. On the other hand, Mongini et al. [32] reported decrease in neck/shoulder pain and headache in a large randomized controlled trial using an unsupervised program. However, none of these two studies were designed to measure the effect of supervision compared to no supervision. Interestingly, ITT analyses in the present study for the group defined as neck-pain cases showed significant decrease in neck pain the last 7 days and the last 3 months in the group with training supervision (3WS) but not for the minimally supervised group (3MS). Thus, we cannot exclude that the pain condition for participants may influence the need for supervision such that patients or those in pain to a larger extend benefit from proper instruction than pain-free participants. To evaluate the effect of the supervision, compliance is crucial. Forty percent of the 3WS group, 48% of 3MS group, and 20% of the REF did not answer the questionnaire after the intervention. This is limiting factor for the study and might induce type 2 error.

Only 60% of completers in the 3WS group and 47% in the 3MS group reported that they were exercising on a regular basis in the intervention period, which may be a limitation when evaluating the effect of the supervision. The reason for these levels of participation may be that supervision is motivating but also causing time constrains, while training without supervision gives more flexibility but may lack motivating actions.

Since noncompleters did not return the questionnaire, we are not able to conclude upon reasons behind not responding on the second questionnaire or upon questions regarding supervision. Noncompleters were in this study defined as those who did not reply the second questionnaire, but as a term, noncompleter is not unambiguous. Although the final questionnaire is not completed, participants could, in principle, have been training a large part of the intervention period. Ongoing evaluation of the included population and a detailed interview could possibly elucidate their training process and outcome.

Dropout and poor compliance are always a challenge in intervention studies [11, 15, 33] and balanced strategies to maintain long-term motivation in studies with exercises interventions are pertinent [17, 18].

5. Conclusion

One hour of physical exercise training per week for 20 weeks at the workplace was highly effective to reduce neck pain and headache and the effect was overall independent of the level of supervision. A well-performed introduction and supervision of the exercises only in the beginning of the relatively simple training program was sufficient to achieve pain-relieving effects. Greater flexibility in planning and conducting exercise training at the workplace due to no constraint with supervised training schedules may have advantages both for the employees and for the employer at a lower cost compared to supervised training.