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EFFECTS OF AN EXERCISE PROGRAMME ON ORGANIZATIONAL/ PSYCHOSOCIAL AND PHYSICAL WORK CONDITIONS, AND PSYCHOSOMATIC SYMPTOMS

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ABSTRACT. The aim of this study was to evaluate the effect of a weekly exercise programme among nursing staff on organizational/psychosocial and physical work conditions, and psychosomatic symptoms. Out of 106 nurses and nursing aides from four geriatric wards who were invited to participate in a cross-over study, 86 accepted. For the exercise periods the staff were invited to participate in an exercise programme twice a week for 8 weeks during work time. Fifty subjects participated ≥ 8 times regularly during the exercise periods (participants). During the control periods, 78 subjects attended without intervention. The effect was followed-up with questionnaires before and after the intervention periods. The exercise programme did not affect perceived organizational/psychosocial or physical work conditions, with one exception. A higher change for the worse was seen in the factor "work planning" during the exercise periods compared with during the control periods. The result suggests that the organization of the training is important in order not to add extra stress.

Key words: exercise; musculoskeletal symptoms; physical and psychosocial work conditions; psychosomatic symptoms.

INTRODUCTION

In Sweden musculoskeletal disorders, especially low back pain and neck and/or shoulder pain, are the most common causes of absence from work in both men and women between 30 and 65 years of age (30). Among different types of employees, nursing personnel are at high risk for back pain (9, 20), and in Sweden nursing aides have reported the highest frequency of work-related back and neck injuries among employed women (28).

It is generally agreed that back pain and other musculoskeletal disorders are multifactorial problems concerning both development and maintenance. Generally, three types of work-related risk factors, individual, physical, and psychosocial factors are investigated and discussed (14). Most of the studies concern low back and neck/shoulder pain, and whereas some of the studies report associations with psychosocial factors (1, 8, 12, 19, 23, 25, 27, 34), others do not (10, 33).

In the extensive review of psychosocial factors at work by Bonger et al. (2), they concluded that monotonous work, high perceived workload, and time pressure were related to musculoskeletal symptoms among workers. Poor control of the job and lack of social support by colleagues were also positively associated with musculoskeletal disease. They also proposed that perceived stress might be an intermediary in this process. The review did not present conclusive evidence, because of the high correlations between psychosocial factors and physical load and the difficulties in defining dependent and independent variables.

A number of previous studies have shown that physical training affects fitness, but an association with change in musculoskeletal problems has also been shown in some studies (11, 18, 32). This has been shown primarily for low back problems (4, 13, 17, 21, 26). Some studies suggest that physical training also improves one's psychological perception of work (5, 6) and psychosomatic symptoms (17), whereas other studies have found no such effect (11). In a review concerning the psychological benefits of exercise in work settings, Jex (18) concluded that the evidence for psychological effects is equivocal.

In a previous analysis we reported that a moderate weekly exercise programme for 8 weeks, performed in a group of nursing staff, positively affected physical capacity and the number of musculoskeletal symptoms. The effect was seen primarily among subjects who did

not exercise regularly (less than once a week) and subjects ≥40 years of age (32). As the results of previous studies vary concerning the effect of physical training on perceived work conditions, it was deemed to be of interest to analyse whether the training in our study had any effect on perceived work conditions.

The aim of this analysis was to evaluate the effect of a weekly exercise programme among nursing staff on organizational/psychosocial and physical work conditions, and psychosomatic symptoms.

MATERIAL AND METHODS

Subjects

The nursing staff, in total 106 nurses and nursing aides working during the day, at four geriatric wards were invited to participate in the study. Reasons for exclusion were pregnancy, medical contraindications to physical training or changing one's job during the study period. Seven subjects (7%) were excluded and another nine (10%) refused to participate before the intervention. During the exercise periods another six subjects (7%) dropped out, but two others were included in the second exercise period. A more detailed description of reasons for exclusion and withdrawal have been presented in an earlier paper (32).

Design

A prospective cross-over design was used. The nursing staff from two out of four wards were assigned to an exercise period, and the staff from the other two wards to a control period, for the first exercise period. After a wash-out period of 4 months, the intervention changed. Assessments were performed before and after each exercise/control period with questionnaires and testing of cardiovascular capacity and muscular strength in m. quadriceps. No intervention took place during the control period. For the exercise period, the staff were invited to participate in an exercise programme twice a week for 8 weeks. Eighty-six subjects attended the exercise periods. Regular participation eight times was the minimal level required in order to be defined as a participant in the exercise period. In total, 50 subjects participated during the exercise periods. Those 36 who did not participate eight times regularly were defined as non-participants. Seventy-eight subjects attended the control periods.

Assessments

The questionnaires were sent home by post to each subject 1–2 months before the exercise periods and again 5 months later. Cardiovascular capacity was tested with a Dynavite computerized exercise bicycle and muscular strength in m. quadriceps, with a Cybex dynamometer about one week before and after the exercise periods in both the exercise and control groups. The results concerning physical capacity have been presented elsewhere (32).

The questionnaire included questions concerning background data (age, sex, family situation, and lifestyle factors such as smoking and exercise habits), musculoskeletal and psychosomatic symptoms, physical and organizational/psychosocial work conditions. A modified version (7) of the Nordic questionnaire on musculoskeletal symptoms (22) was used to assess the number of musculoskeletal symptoms. In the questionnaire the subjects stated whether they had had symptoms from seven areas in the back and upper extremities during the previous six months and if the symptoms had forced them to be off work. In the questionnaire for the number of psychosomatic symptoms, the subjects stated (yes/no) whether they had, for instance, a feeling of tiredness, headache, insomnia, signs of gastritis, and so on. There were 12 items in total (29). Concerning physical work conditions the subjects answered nine questions ("Does your work usually consist of ..."). Ratings were made on a 7-point scale with the endpoints "not at all–to a very high extent". The questions include five factors; heavy lifting, demanding working positions, high work pace, high demands on concentration and precision, and mainly sitting. Each individual's factor score is calculated as the arithmetical mean of each subject's ratings on items included in the factor. Finally, concerning perceived organizational/psychosocial work conditions, a questionnaire, consisting of 52 questions, that has been constructed and tested for its validity by Ekberg et al. (8) was used. Ratings were made on a 7-point scale with endpoints of the type "not at all–to a large extent". The questions include eight factors; work climate, work content, work pace, demands on attention, work planning, job security, job constraints and work-role ambiguity. Each individual's factor score is calculated as the arithmetical mean of each subject's ratings on items included in the factor (8). Examples of the items are presented in Table I in Appendix 1.

Table I. *Characteristics of the study population concerning perceived organizational/psychosocial work conditions and physical work conditions mean (SD) before the control and exercise periods. No significant difference between the groups*

		Exercise periods	
	Control periods $n = 78$[b]	Participants $n = 50$[b]	Non-participants[a] $n = 36$[b]
Organizational/psychosocial work conditions			
Work climate	2.6 (1.0)	2.7 (1.1)	2.5 (1.0)
Work content	3.9 (0.8)	3.8 (0.8)	3.8 (0.9)
Work pace	4.9 (1.1)	4.7 (1.4)	4.6 (1.1)
Demands on attention	6.1 (0.8)	5.9 (0.9)	6.0 (1.0)
Work planning	2.9 (1.2)	3.0 (1.4)	2.7 (1.2)
Job security	2.7 (1.2)	2.6 (1.2)	2.7 (1.0)
Job constraints	3.8 (1.8)	4.4 (1.7)	4.0 (1.8)
Work role ambiguity	2.4 (1.1)	2.5 (1.4)	2.3 (1.0)
Physical work conditions			
Heavy lifting	6.0 (1.5)	6.0 (1.2)	6.0 (1.3)
Working position	4.8 (1.4)	4.6 (1.6)	5.2 (1.5)
High work pace	5.4 (1.3)	5.1 (1.4)	5.3 (1.5)
Concentration and precision	4.6 (1.3)	4.7 (1.5)	5.0 (1.4)
Mainly sitting	1.4 (0.8)	1.4 (0.9)	1.7 (1.4)

[a] Non-participants = those who participated irregularly or 0–7 times.
[b] 1–2 missing values in some of the items.
Higher values indicate a change for the worse.

Exercise programme

The exercise groups were invited to participate twice a week during working hours in a 45-minute long exercise session, performed in close connection to the wards. Eight opportunities per week were offered to make it possible for all part-time workers to participate. As considerable differences were observed in the participants' exercise level the leaders helped the participants to individualize the exercises if needed. It was emphasized that the participants had to find an intensity level that suited them according to age and physical capacity, and that did not cause pain or increased pain after the session.

The exercise programme was based on the same principles as exercise programmes offered to different companies by Korpen (Inter-company Sport, Sweden). It was conducted to music and included warming-up movements, general strength exercises and cardiovascular capacity exercises. The programme ended with winding-down, stretching exercises and relaxation (32).

Analysis and statistics

An analysis of covariance was conducted to decide whether it was possible to combine the two exercise periods and the two control periods. The analysis confirmed that the effects were not due to differences between the groups before the exercise periods or a carry-over effect, thus allowing us to combine the two exercise periods and the two control periods in the analysis (15). This was also confirmed by the fact that the characteristics of the tested variables were virtually the same at the start of the two intervention periods.

The comparisons were made in three steps. First, the different periods, exercise ($n = 86$) and control periods ($n = 78$) were compared. Secondly, the population within the exercise periods was divided into two groups, participants ($n = 50$) and non-participants ($n = 36$). Finally, the same analyses were performed according to groupings. The groupings were exercisers/non-regular exercisers (non-regular exercisers = subjects who exercised less than once a week in their spare time) and subjects $\geq 40/<40$ years of age. The groupings were chosen according to previous subgroup analysis (32).

X^2 tests were used on the background data to detect any significant differences between groups before the interventions. Furthermore, a bivariate correlation analysis (Pearson's r) was performed both between the different factors concerning perceived organizational/psychosocial and physical work conditions and between number of musculoskeletal and the number of psychosomatic symptoms at entry.

As we used a cross-over design, the exercise periods and control periods in the study population cannot be considered as independent groups. Therefore a paired test was used to make a comparison between the exercise and control periods. A two-sample group test was used in the comparison of changes between groups and paired test within groups. Non-parametric tests, Mann-Whitney and Wilcoxon's signed-ranks sum test, and *t*-tests were used, because it could not be confirmed whether the material was normally distributed and because some subgroups were small. The parametric and non-parametric tests showed similar results. So the results for *t*-tests are presented. All *p*-values are two-sided. The level of significance was set at = 0.05.

RESULTS

Group characteristics at entry

No difference in group characteristics could be seen at entry to the intervention periods between the subjects in the exercise and control periods, or between participants and non-participants concerning perceived organizational/psychosocial and physical work conditions (Table I). Nor was there any difference between periods or groups in any of the measured dimensions, background data (age, percent ≥ 40 years of age and regular exercisers) oxygen uptake capacity, muscle strength, the number of musculoskeletal and psychosomatic symptoms or proportion of subjects reporting musculoskeletal problems from different localizations. Only concerning smoking was a significant difference seen between participants (28%) and non-participants (56%) (32). Musculoskeletal problems were most commonly reported from the lower back (64%) followed by neck (38%) and shoulders (33%). Fourteen percent of the subjects reported that they had been off work during the previous six months because of disorders from one or more of the seven localizations.

The correlations were low, $r \leq 0.35$ between different factors for perceived organizational/psychosocial and physical work conditions and the number of both musculoskeletal and psychosomatic symptoms, and few correlations were significant (Table II). The factor

Table II. *Correlation (r) and significance level for the correlation between factors for organizational/psychosocial and physical work conditions and the number of both musculoskeletal and psychosomatic symptoms before the intervention periods* (n = *86*)

	No. of musculoskeletal symptoms	No. of psychosomatic symptoms
Organizational/psychosocial work conditions		
Work climate	0.12	0.10
Work content	0.21	0.05
Work pace	0.35***	0.33**
Demands on attention	0.10	0.16
Work planning	0.14	0.10
Job security	0.12	0.13
Job constraints	0.05	−0.01
Work-role ambiguity	0.11	0.25*
Physical work conditions		
Heavy lifting	0.21	0.12
Working position	0.30**	0.12
High work pace	0.23*	0.10
Concentration and precision	0.10	−0.00
Mainly sitting	0.12	−0.03

1–2 missing values in some of the items.
* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Table III. *Changes in the different factors for organizational/psychosocial and physical work conditions, mean (SD) and analysis within groups with paired* t-*test*

	Control periods $n = 78$ [b]	Exercise periods $n = 86$ [b]	Exercise periods: Participants $n = 50$ [b]	Exercise periods: Non-participants[a] $n = 36$[b]
Study population				
Organization/psychosocial work conditions				
Work climate	0.10 (0.57)	0.01 (0.62)	−0.12 (0.60)	0.20 (0.61)
Work content	−0.06 (0.57)	−0.01 (0.53)	−0.11 (0.46)	0.13 (0.60)
Work pace	−0.31 (0.71)***	−0.07 (1.00)	−0.24 (1.04)	0.15 (0.90)
Demands on attention	−0.10 (0.85)	−0.10 (0.74)	−0.10 (0.69)	−0.10 (0.82)
Work planning	0.12 (0.93)	0.49 (1.16)***	0.60 (1.26)**	0.33 (1.00)
Job security	0.37 (1.04)**	0.20 (0.98)	0.07 (1.05)	0.40 (0.87)**
Job constraints	−0.20 (1.83)	−0.24 (1.85)	−0.20 (1.95)	−0.31 (1.74)
Work role ambiguity	0.03 (1.04)	−0.01 (0.95)	−0.06 (1.04)	0.07 (0.80)
Physical work conditions				
Heavy lifting	−0.12 (1.00)	−0.07 (0.84)	−0.10 (0.84)	−0.03 (0.85)
Working position	−0.04 (0.75)	0.04 (0.83)	−0.02 (0.86)	0.11 (0.80)
High work pace	−0.30 (1.04)*	0.08 (1.25)	−0.08 (1.29)	0.31 (1.17)
Concentration and precision	0.28 (0.97)*	−0.23 (1.02)	−0.01 (1.02)	−0.04 (1.05)
Mainly sitting	0.08 (0.83)	−0.07 (0.78)	−0.04 (0.57)	−0.11 (1.01)

[a] Non-participants = those who participated irregularly or 0–7 times.
[b] 1–2 missing values in a couple of the factors.
* $p \leq 0.05$,** $p \leq 0.01$,*** $p \leq 0.001$.

"work pace" correlated significantly with the number of both musculoskeletal and psychosomatic symptoms. The number of musculoskeletal and psychosomatic symptoms did not correlate significantly ($r = 0.15$).

Step one—comparison between exercise and control periods

A higher change for the worse was seen during the exercise periods than during the control periods in the factor "work planning". Concerning physical work conditions, a difference in change was seen between the control periods and the exercise periods in the factor "high work pace".

The paired *t*-test (Table III) showed a significant change for the worse in the factors "work planning" within the exercise periods and "concentration and precision" within the control periods. Improvements were seen in the factors "work pace" and "high work pace" within the control periods. "Job security" changed for the worse within both the control and exercise periods.

Changes in the number of musculoskeletal and psychosomatic symptoms correlated significantly ($p = 0.01$), the regression coefficient was $r = 0.28$. No correlations between changes in the number of musculoskeletal or psychosomatic symptoms and changes in perceived work conditions were found.

Step two—comparison between participants and non-participants

The paired *t*-test (Table III) showed change for the worse in the factor "work planning" among the participants and in "job security" among the non-participants.

Step three—analysis according to subgroups

The pattern of change in the first and second steps of the analysis and in the test within groups was not considerably altered when age and exercise pattern were used as subgroupings.

DISCUSSION

The study suggests that a weekly exercise programme carried out during working hours twice a week did not affect perceived organizational/psychosocial or physical work conditions in nursing staff, with one exception. The

factor perceived "work planning" changed for the worse during the exercise periods, primarily among the participants. All changes within periods and groups, except for the factor "work planning", were low (≤0.40) and considered of no clinical interest.

The deterioration in the factor "work planning" was primarily observed during exercise periods and among those who participated, suggesting that the training, besides improving of physical capacity and reducing the number of musculoskeletal symptoms (32), had a deteriorating effect on perceived work planning. Gerdle et al. (11) reported similar findings in homecare staff. They used an organization of the fitness training similar to our own (mixed exercise programme in groups, during working hours, twice a week). In our study the employees decided themselves when they could participate, who should participate when, and, from one session to the other, whether it was possible to participate because of the work and amount of personnel available. No extra personnel was offered in any of these studies. One reason for not gaining similar improvements as presented in some previous studies (5, 6, 17) might be that a higher level of stress, expressed as a change for the worse in work planning, was introduced. This might be explained by the organization of the training, the fact that it was during working hours and that no extra personnel was available.

In a cross-sectional and mixed longitudinal cohort study of 902 employees in metal factories, Leino showed that musculoskeletal symptoms covaried with stress symptoms. The stress symptom score (18 symptom questions similar to our 12 psychosomatic symptom questions) at baseline 1973 was associated with rheumatic symptoms (number and grade of musculoskeletal disorders) and mean stress symptoms at baseline and 5 years later and predicted the level of rheumatic symptoms 5 and 10 years later (24). Gerdle et al. (12) reported a relationship between the number of musculoskeletal symptoms, number of psychosomatic symptoms and anxiety in homecare service personnel and Houtman et al. (16) that psychosocial work stressors were associated with both musculoskeletal and psychosomatic problems. Our results were partly in line with these studies. The number of musculoskeletal and psychosomatic symptoms did not correlate before the interventions, but the changes during the exercise periods correlated, suggesting an association.

Three types of explanations for the association between work-related psychosocial factors and musculoskeletal disorders have been suggested by several investigators (2, 31) and (35). These explanations are 1) psychosocial demands and job stress may produce increased muscle tension and exacerbate task-related biomechanical strain, 2) psychosocial demands may affect awareness and reporting of musculoskeletal symptoms, or affect perception of their cause, or 3) the association may be related to a causal or correlational relationship between psychosocial and physical demands. Sauter & Swanson (31) present a model of musculoskeletal disorders in the workplace that include all three explanations. They integrated a generic psychosocial stress process into the traditional biomechanical model of musculoskeletal disorders and gave extra attention to cognitive processes as mediators between biomechanical strain and musculoskeletal disorders. Boos et al. (3) presented a biopsychic explanation to low back pain. Patients with sciatica requiring a dissectomy were compared with a matched sample without pain. They found that besides the extent of neural compromise, even work perception, mental stress, intensity of concentration, job satisfaction and psychosocial factors differed significantly between the groups, which suggests that verified biological factors were associated with work perception and psychosocial factors. We did not find any association between changes in the number of musculoskeletal symptoms and organizational/psychosocial work conditions; but on the other hand, we did find a correlation between changes in musculoskeletal and psychosomatic symptoms. None of the explanations by Sauter & Swanson (31) or Boos et al. (3) could fully explain the effect of exercise on the number of musculoskeletal symptoms in our study. This might be due to the fact that our study included both individuals with and those without any musculoskeletal symptoms.

CONCLUSION

The results suggest that a moderate weekly exercise programme performed during working hours among nursing staff did not improve perceived working conditions, but had a deleterious effect on perceived work planning. This suggests that the organization of training during working hours is important in order not to increase stress. An association between a change in the number of musculoskeletal and psychosomatic symptoms was also suggested. Further research is needed to analyse the relationships between different factors such as change in physical capacity, perceived musculoskeletal and psychosomatic symptoms in order to confirm

whether relationships do exist and to describe what type of relationships they are.

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APPENDIX 1

Table I. *The factors for organizational/psychosocial work conditions*

Factor	Sample item in the factor
1. Work climate	Do you and your closest superior usually discuss problems that arise in your work? What is the contact and cooperation like with your nearest workmates?
2. Work content	Is your job varied enough?
3. Work pace	Do you usually feel rushed at work?
4. Demands on attention	Does your job place high demands on attention?
5. Work planning	Is your job obstructed by lack of planning or unnecessary routines?
6. Job security	Do you feel worried that your workplace will be reorganized?
7. Job constraints	Is your job bound to firm routines (e.g. by apparatuses or rules)?
8. Work-role ambiguity	Are you in doubt about how to perform your tasks in the best way?