

# Exercises and education as secondary prevention for recurrent low back pain

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**ABSTRACT Background and Purpose.** *Exercise and education is a common physiotherapy approach in the prevention of low back pain. A Mensendieck exercise programme consisting of exercises and ergonomical education has, in a previous study, been shown to be effective in preventing recurrent low back pain during one-year follow-up. The purpose of the present study was to evaluate the long-term effect of the Mensendieck exercise programme on people with recurrent episodes of low back pain who, when entering the study, had finished treatment for their last episode of low back pain. Method.* A randomized controlled clinical trial in which 41 women and 36 men were allocated to either a Mensendieck or control group. The Mensendieck subjects received 20 group sessions of exercises and ergonomical education over 13 weeks. The control subjects were not offered any prophylactic therapy, but were free to receive treatment or exercises. Outcome measures were the number of recurrences of low back pain, sick leave, low back function and general functional status. **Results.** At three-year follow-up, 11 subjects had been lost to the study. Survival analysis showed a significant reduction ( $p=0.02$ ) in subjects experiencing recurrent low back pain in the Mensendieck group compared to the control group. Significant improvements in pain and function scores were reported in both groups. There was no significant difference between the groups in pain, function or sick leave. **Conclusion.** A Mensendieck exercise programme seems efficient in reducing recurrent episodes of low back pain at three-year follow-up, but it did not influence sick leave, pain or function scores.

**Key words:** low back pain, Mensendieck exercise, physiotherapy, secondary prevention

## INTRODUCTION

The recurrent pattern of low back pain is well documented (Riihimäki et al., 1989; Battie and Bigos, 1991; Von Korff et al., 1993) and patients with recurrent low back

pain represent a great challenge for most clinicians in outpatient physiotherapy practice (Jette et al., 1994; Jette and Delitto, 1997). Exercises and education are basic elements in several physiotherapy approaches to prevent low back pain and

there is an increasing amount of evidence documenting the efficacy of different exercise programmes in the conservative management of the condition (van Tulder et al., 1997; Mannion et al., 1999; Moffett et al., 1999). It also seems that exercise programmes can be an inexpensive and cost-effective intervention for patients with recurrent and chronic low back pain (Mannion et al., 1999; Moffett et al., 1999). However, most of the exercise programmes which have been evaluated in randomized controlled trials have been directed at patients with chronic low back pain (Frost et al., 1995; Johannsen et al., 1995; Bendix et al., 1997; Frost et al., 1998; Torstensen et al., 1998). There is a need to investigate whether exercise programmes might have a preventive effect on low back pain before the condition has reached a chronic pattern.

Studies with a focus on secondary prevention of low back pain have not been widely evaluated in the literature. Linton and coworkers (1989) carried out a randomized controlled trial to assess the efficacy of a physical and behavioural preventative intervention on nurses at high risk of developing a chronic back problem and reported significant improvements in pain and other psychological outcome variables. Donchin and coworkers (1990) showed that an exercise programme had a significant effect on a group of hospital employees with a history of recurrent low back pain. A secondary preventative exercise programme combined with education was also found to be effective in preventing episodes of low back pain and sick leave in a study by Kellett and coworkers (1991). On the other hand, a study by Daltroy and coworkers (1997), to evaluate an educational programme in the prevention of low back pain, reported no effect on people at risk of low back pain. In summary, despite variations in type of intervention, most of these studies suggest that a

secondary approach, combining exercises and education, can be efficient in preventing chronic low back pain.

The present study comprised a three-year follow-up of a randomized controlled trial on the outcome of a Mensendieck exercise programme which combined exercises and ergonomical education. In a Mensendieck approach, subjects are encouraged to perform daily life movements and activities using optimal body postures, body mechanics and ergonomics (Aubert, 1997; Soukup et al., 1999). The main emphasis of Mensendieck exercises is on co-ordination of body movements, with special attention to the performance of movements in daily life activities. Moreover, educational elements are integral to the exercise instructions, thus emphasizing the principle of 'learning by doing'.

The subjects included in the study were at high risk of recurrent low back pain; based on their history. The results of the one-year follow-up showed that 20 sessions with Mensendieck exercises and education significantly reduced the incidence of recurrent low back pain (Soukup et al., 1999). Here, the outcomes of episodes of low back pain, days of sick leave, low back function and general functional status are evaluated three years after the intervention. In addition, data about circumstances relating to the onset of episode(s) of low back pain are reported. The underlying hypothesis of the study was that a Mensendieck exercise programme would have a long term preventative effect on recurrent low back pain in people with a history of the condition.

## METHOD

### Study design and allocation procedure

The study comprised a three-year follow-up evaluation of subjects enrolled in an open,

prospective, randomized, controlled trial. After attending the baseline examination, subjects were assigned a number for the randomization procedure. In order to ensure equal distribution of the most important factors between the groups, a stratified parallel group design was used. Subjects were prestratified according to pain radiation by the Slump test (Butler, 1991) and number of episodes of low back pain during the 36 months prior to inclusion in the study (Soukup et al., 1999). These stratification factors were chosen for their potential prognostic effects (Heliövaara, 1989; Riihimäki et al., 1989; Battie and Bigos, 1991; Von Korff et al., 1993). Within each of six blocks, subjects were allocated to either a Mensendieck or control group by block randomization with random block size. The stratification and randomization procedure was carried out by an independent medical statistical unit. Data were gathered at five and 12 months (Soukup et al., 1999) with an additional follow-up observation three years after the intervention.

### Study population

Most subjects were recruited from different outpatient medical, chiropractic and physiotherapy practices in a city in south-east Norway. Approximately one-third of the sample was recruited following a local media advertisement. Subjects were aged between 18 and 50 years and had experienced at least one episode of low back pain. The pain was localized to the lumbar region, with or without pain radiation to the lower extremities, during the last year. All the subjects had finished treatment for their last episode of low back pain and had returned to work at the time of inclusion in the study. Subjects with previous back surgery, pregnancy, specific rheumatological diseases, spondylolisthesis, spinal tumor

or spinal fracture, subjects with drug or alcohol abuse or who were suffering from verified mental disorders were excluded from the study. Before entry to the study all subjects received both oral and written information about the project, including ethical considerations, and signed a written consent form. The study protocol was approved by the regional ethical committee.

### The Mensendieck exercise programme

Nineteen females and 16 males ( $n=35$ ) participated in the Mensendieck exercise programme. Three subjects allocated to the Mensendieck group withdrew from the study before the intervention started (Table 1). The programme was performed with classes of 6–10 subjects for a total of 20 sessions of exercises and education, each lasting one hour, over a period of 13 weeks. Each session started with 10 minutes' warm-up exercises followed by five minutes of stretching exercises for muscle groups in the buttocks and lower extremities. During the next 35 minutes different types of exercises were in focus, depending on the educational topic for the session. Each session ended with approximately five minutes' stretching exercises and five minutes' relaxation carried out to appropriate music. The educational elements, which were integrated into the exercise instructions, included educational topics such as back anatomy and physiology, pain mechanisms, coping with recurrent pain, working postures, lifting techniques and the purpose and value of different types of exercises performed in the programme.

The great differences between subjects with regard to their pain severity and physical fitness meant that emphasis was placed on repetition of less-demanding exercises to enhance muscular endurance, strength and co-ordination. A graded progression of the

TABLE 1: Time and reasons for drop-out in the Mensendieck and control groups during three-year follow-up

<i>Drop-out: time and reason</i>	<i>Mensendieck group (n=39)</i>	<i>Control group (n=38)</i>
Initially	Did not return after first examination Unknown reason (n=1) Alterations in work situation (n=2)	
During intervention	Difficulties with scheduling (n=1)	Moved to another city (n=1) Disappointed with allocation (n=2)
5 months – 1 year 1–3 years	Pregnancy (n=1) Multiple sclerosis (n=1) Spinal surgery (n=1) Pregnancy (n=1)	
Total number of drop-outs	8	3
Total number of subjects in the final analysis	31	35
A total drop-out rate of 14%		

exercise 'dosage' throughout the programme was emphasized. In addition, subjects were encouraged to apply the ergonomic principles of the programme into their daily activities and to continue regular physical activity and self-care training after finishing the programme. No refresher course was offered.

### The control group

Nineteen females and 19 males (n=38) were allocated to the control group. Subjects performed the same examination and structured interview as the Mensendieck group. No treatment was offered, but subjects were free to receive other treatment or exercises. These activities were recorded in the follow-up examinations.

### Questionnaire and assessments

At the time of inclusion in the study, all subjects underwent a brief clinical examination, assessing neurological symptoms by the Slump test and motor loss (Butler,

1991). In addition, subject answered a questionnaire, which included information about sociodemographic status, previous episodes of low back pain and taking sick leave due to the condition, satisfaction at work and home/leisure, smoking habits, use of medication, and regular exercise habits during leisure time. The following assessments of pain and functional status were also included for each subject.

- Pain intensity during the last month was recorded by series of 100 mm visual analogue scales (VAS) with the endpoints of 'No pain' = 0 and 'Worst imaginable pain' = 100. Pain intensity was measured both for general back pain and back pain related to the 12 daily activities of walking, sitting, bending, standing, sleeping/lying down, lifting/carrying, driving, dressing, housework, gardening, exercising and working.
- Low back function during the last month was also assessed on a 100 mm VAS with the endpoints of 'Very bad' = 0 and 'Excellent' = 100. The validity and reliability

bility of subjective pain evaluations by VAS scales are well documented (Huskinsson, 1974; Larsen et al., 1991).

• General functional status was assessed by The Dartmouth COOP Functional Status Assessment Charts, developed by the World Organization of Family Doctors (COOP-WONCAs). This instrument consists of the items: Physical fitness; Pain; Emotional problems; Limitation of social activities due to health condition; Problem with daily activities due to health condition; General health condition and Quality of life (Scholten and Van Weel, 1992; Bentsen et al., 1997). Each item was assessed on a five-point scale, from 'Very good' = 1 to 'Very bad' = 5. The COOP/WONCA charts have been found to be reproducible and valid (Scholten and Van Weel, 1992; Bentsen et al., 1997).

To evaluate the length, content, formulations and general acceptability of this questionnaire, it was pilot-tested on some patients and physiotherapist colleagues in the planning phase of the trial. At three-year follow-up the questionnaire contained some additional variables. Since the main outcome measure was 'recurrence of LBP-episodes', data on this subject were recorded. An episode of low back pain was defined as low back pain resulting in healthcare contact or use of sick leave due to the condition. The date of the first recurrent episode of low back pain in the follow-up period was recorded. In addition, the total number of episodes of low back pain, type and frequency of healthcare contact, and number of days of sick leave due to the condition were recorded. At three-year follow-up, subjects also recorded low back function over the last two years on a VAS. Further, subjects were asked about circumstances related to initiation of the last

episode of low back pain and about their opinion on which movements, activities or circumstances they considered as most likely to precipitate or prolong low back pain.

### Statistical analyses

The analysis was carried out in accordance with the principal of intention-to-treat (ITT) and per-protocol (PP). In case of discrepancies between the two analyses, the results from ITT are reported. Otherwise the results from the PP analysis are given.

The results from continuously distributed factors and variables were expressed as mean values with 95% confidence interval (95% CI) constructed by use of the Student's *t* test (Altman, 1991). As indices of dispersion both standard deviations (SDs) and total range were used. Variables such as 'Time from inclusion to first LBP-episode' were expressed graphically in Kaplan and Meier plots (Lee, 1992). Categorical factors and variables were presented in contingency tables (Altman, 1991). To give a summarized overview of pain, an overall 'pain experienced' score was defined. This score was defined as the average of pain in general and in relation to 12 different daily activities.

All tests were carried out two-tailed with a significance level of 5%. The sample size was determined by power analysis on the main variable. By using a significance level of 5%, clinically relevant differences of  $1 \times$  SD, a power of 95% and correcting for the stratification, at least 31 subjects had to complete the study in each group (Larsen et al., 1991b). In order to perform an ITT analysis, data from subjects discontinuing the study were gathered in two cases. For the remaining cases, the last-observation-carried-forward (LOCF) procedure was used (Colton, 1974). Comparison of groups with regard to assumed continuously distributed variables

was performed by analysis of variance (ANOVA) with the stratification factors and the initial value of the variable in question as covariates (Kleinbaum et al., 1988). The stratification factors were the number of episodes of low back pain three years prior to enrolment and radiating pain assessed by the Slump test. In the case of skewed distributions, nonparametric methods were used (Altman, 1991). Changes within groups were performed by including repeated measurements in the model (Kleinbaum et al., 1988).

Comparison of groups with regard to 'Time from inclusion to first LBP-episode' was performed by use of Gehan's test (Lee, 1992). Categorized data were analysed by use of contingency table analysis (Altman, 1991). The ordinal data of the COOP/WONCA charts were analysed by use of contingency tables and the nonparametric Mann-Whitney U test (Altman, 1991). A sum score of the parameters was developed, and tested with regard to differences within the groups by a one-sample Student's *t*-test, and between the groups with ANOVA. A higher score indicated reduced general functional status.

Data regarding circumstances associated with low back pain were analysed by a content analysis of subjects' answers, resulting in categories. Description of the categories and their frequency are given in the Results. Differences in frequencies between the two groups were not computed because of the small number of respondents.

## RESULTS

### Drop-out and study sample at three-year follow-up

The baseline sample consisted of 41 females and 36 males, in which 39 subjects were allocated to the Mensendieck group and 38 sub-

jects to the control group. At three-year follow-up, the study sample was reduced to 31 subjects in the Mensendieck group and 35 subjects in the control group due to the drop-out of 11 study subjects. Time points and reasons for drop-out in the two groups are shown in Table 1. Those who dropped out tended to be younger, were likely to be female, have more pain radiation to lower extremity, have taken more sick leave during the three years prior to the study and have higher rates of unemployment and smoking than the subjects who completed the study (Table 2).

There were no statistically significant differences in baseline characteristics between the Mensendieck and control groups with regard to most of the variables included (Table 2). However, the control group had a significantly larger ( $p < 0.05$ ) proportion of participants who performed regular exercising during leisure time.

### Adherence in terms of regular exercising during leisure time

During the first year of follow-up there was an increase in number of subjects in the Mensendieck group ( $n = 24$ ) who performed regular exercising during leisure time. However, at three-year follow-up this number decreased ( $n = 18$ ). In the control group, the number of subjects who performed regular exercise during leisure time remained stable both at one-year ( $n = 28$ ) and three-year follow-up ( $n = 24$ ). At three-year follow-up there was no significant difference between the groups in reports of regular exercise habits.

### Recurrence of episodes of low back pain

From baseline to three-year follow-up a total of 18 subjects (58%) in the Mensendieck

TABLE 2: Baseline characteristics\* of subjects in the Mensendieck and control groups who completed three-year follow-up and subjects who dropped out

	Mensendieck group (n=31)	Control group (n=35)	Drop-out group (n=11)
Female/male (%)	16/15 (52/48)	17/18 (49/51)	7/4 (64/36)
Age (years)	40.4 (7.8)	38.9 (6.6)	33.9 (9.7)
Height (cm)	176 (8)	177 (8)	172 (12)
Body mass index (kg/m <sup>2</sup> )	24.4 (3.4)	24.9 (3.2)	26.5 (4.9)
Pain without radiation to lower extremity (%)	8 (26)	6 (17)	6 (55)
Sick leave three years prior to inclusion (days)	38.8 (48.4)	54.1 (73.3)	54.9 (95.9)
Participants with sick leave three years prior to inclusion (%)	15 (48)	12 (34)	8 (73)
LBP-episodes three years prior to inclusion (%):			
1	5 (16)	4 (11)	1 (9)
2-4	16 (52)	17 (49)	7 (64)
>5	10 (32)	14 (40)	3 (27)
Employment status (%):			
Full-time work	24 (78)	28 (80)	6 (55)
Part-time work	2 (6)	1 (3)	0 (0)
Homemakers/unemployed	5 (16)	6 (17)	5 (45)
Satisfaction at work (mm in VAS)	85.9 (16.7)	81.5 (21.0)	76.8 (31.0)
Regular exercising during leisure time (%)	15 (48)**	26 (74)**	7 (64)
Periodically use of medication for LBP (%)	10 (32)	7 (20)	4 (36)
Current smoker (%)	10 (32)	12 (34)	7 (63)

\*Summary statistics are given in mean with standard deviation (SD) in brackets or in number per category with percentages in brackets. No statistically significant differences were found between subjects in the Mensendieck and control groups.

\*\*Statistically significant difference ( $p < 0.05$ ).

VAS = visual analogue scale.

group and 27 subjects (77%) in the control group had recurrent episodes of low back pain (Fisher's exact test;  $p = 0.17$ ). Results from the survival analysis showed a significant reduction in time until first recurrent episode of low back pain ( $p = 0.02$ ) in the control group compared to the Mensendieck group (Figure 1). There was a total of 32 episodes of low back pain in the Mensendieck group and 105 episodes of the condition in the control group ( $p = 0.03$ ). The conclusions of the results regarding recurrences of low back pain did not change when the ITT analysis was performed.

Fourteen subjects in the Mensendieck group and 20 subjects in the control group who had experienced recurrent low back

pain between the one-year and three-year follow-ups reported on the initiation of their last episode of low back pain. Seven subjects in the Mensendieck group and 11 in the control group identified an acute onset, and seven subjects in the Mensendieck group and nine in the control group reported a gradual course with increased stiffness and pain. Approximately one-third of the subjects in both groups reported stress/exhaustion as the main reason for onset of their last episode of low back pain. Another one-third of subjects reported sudden movement and forward bending/twisting, whereas the remainder of subjects could not identify any reason for pain onset.

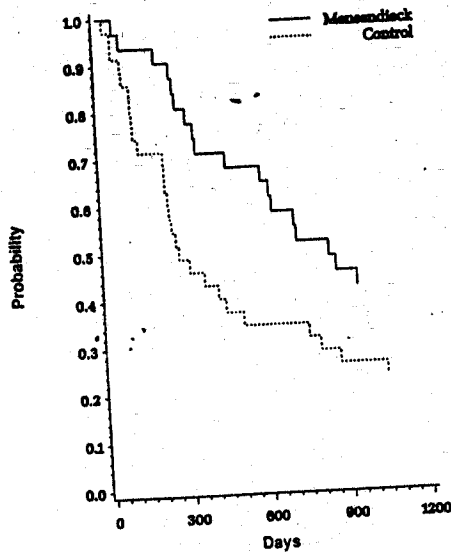


FIGURE 1: Probability of not having recurrences of episodes of low back pain during three years' follow-up, expressed by a Kaplan and Meier plot. Horizontal axis shows time until day of the first recurrent episode; vertical axis shows probability for survival in the Mensendieck (—) and control groups (.....).

### Sick leave during three years' follow-up

From one- to three-year follow-up, a total of nine subjects (29%) in the Mensendieck group and 14 subjects (40%) in the control group had sick leave due to low back pain. Mean duration of sick leave in the Mensendieck group was 46.3 days (SD 57.8 days) and in the control group 52.5 days (SD 56.3 days). From baseline to three-year follow-up 13 subjects (42%) in the Mensendieck group and 18 subjects (51%) in the control group used sick leave due to low back pain. Mean days' use of sick leave was 52.4 (SD 97.9) in the Mensendieck group and 63.9 (SD 76.3) in the control group. No statistically significant differences between the groups, either in the period from one- to three-year follow-up ( $p = 0.61$ ) or for the total period from baseline to three-year follow-up ( $p = 0.35$ ), were found.

### Pain severity (VAS)

There was a significant reduction in the overall back pain score within both groups during three years of follow-up (Figure 2). However, a tendency to a larger reduction in the Mensendieck group was found, but the difference did not reach the level of significance (ANOVA;  $p = 0.19$ ). Subjects considered the following factors most likely to precipitate or prolong episodes of low back pain (they could report more than one situation that provoked the condition):

- Lifting (heavy or with inadequate technique) ( $n = 21$ ).
- Prolonged standing ( $n = 18$ ) and sitting ( $n = 17$ ).
- Forward bending and/or twisting ( $n = 16$ ).
- Gardening ( $n = 10$ ).
- Little regular physical activity ( $n = 9$ ).

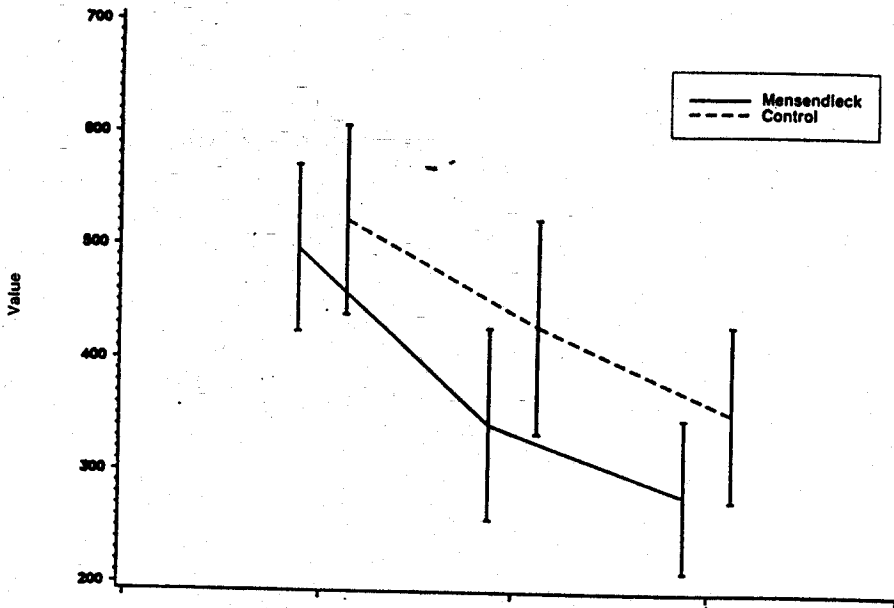


FIGURE 2: Overall mean score (with standard deviation) of 13 pain variables (general low back pain and pain related to 12 daily activities) at baseline, one-year and three-year follow-up.

- Housework ( $n = 8$ ).
- Walking ( $n = 8$ ).
- Lying supine ( $n=8$ ).
- Stress ( $n = 7$ ).
- Work ( $n=6$ ).
- Uncontrolled, sudden movements ( $n = 3$ ).

Other factors considered were cold weather, menstruation, car-driving for several hours and monotonous working.

### Low back function (VAS)

In the Mensendieck group mean low back function scores increased from 40 (SD 21) at baseline to 59 (SD 23) at one-year follow-up and 60 (SD 20) at three-year follow-up. In the control group mean low back function increased from 41 (SD 19) at baseline to 52 (SD 23) at one-year follow-up and 61 (SD 21) at three-year follow-up. There were no significant differences

between the groups. Mean score of self-reported low back function over the last two years was 57 (SD 15) in the Mensendieck group and 53 (SD 21) in the control group.

### General functional status (COOP/WONCA charts)

At baseline, mean sum score of the COOP/WONCA parameters was 16.3 (SD 5.2) in the Mensendieck group and 16.1 (SD 4.9) in the control group. At one-year follow-up mean sum score was 14.5 (SD 5.6) in the Mensendieck group and 15.3 (SD 5.6) in the control group. At three-year follow-up there was an improvement in general functional status with a mean sum score of 12.9 (SD 3.7) in the Mensendieck group and 14.5 (SD 4.4) in the control group. The difference between the groups did not reach the level of significance (ANOVA;  $p = 0.09$ ) at three-year follow-up.

## DISCUSSION

The present study focused on the secondary prevention of low back pain. Most of the subjects had experienced several episodes of low back pain during the years prior to inclusion in the study and had a high risk of recurrent low back pain (Riihimäki et al., 1989; Battie and Bigos, 1991; Von Korff et al., 1993). Subjects were partly recruited from different outpatient practices in primary care, and partly from respondents to a local media advertisement, thus representing a group with high motivation for doing something to prevent recurrence of their low back pain. The main finding at three-year follow-up was that the Mensendieck group still had a significant reduction in recurrences of low back pain compared to the control group. Moreover, both groups showed improvement in pain and function scores, but there was no significant difference between the groups. The Mensendieck programme did not appear to have an effect on subjects' use of sick leave.

The positive results regarding recurrent low back pain in the Mensendieck group, which in this context meant reduced healthcare contacts, could be due to increased understanding of the condition and how to cope with future episodes of low back pain. This might have positively influenced subjects' need to seek healthcare for episodes of low back pain. The unchanged pattern of regular exercise habits in the Mensendieck group makes unlikely the hypothesis that improved exercise habits contributed to the positive findings of the study. However, the improved pain and function scores in the control group might be attributed to the regular exercise habits because these subjects had a very stable pattern of regular exercise throughout the follow-up period. This finding is supported by recent evidence which reports that leisure time physical activity is

associated with less likelihood of suffering from low back pain (Harreby et al., 1997; Heistaro et al., 1998). Difficulties with obtaining adherence to exercises over the long term have been reported in other studies evaluating exercise and education programmes as well (Sluijs and Knibbe, 1991; Friedrich et al., 1998). In the present study adherence to exercises might have been improved with the use of behavioural techniques (Sluijs and Knibbe, 1991) or by offering subjects follow-up training classes after the intervention period.

Despite the reduction in recurrent episodes of low back pain and the high job satisfaction in the study sample, the Mensendieck programme had no impact on use of sick leave due to low back pain. These results are similar to those reported by Härkäpää and coworkers (1990) and Linton and Bradley (1992). However, due to several potential confounding influences from psychological, social and economic determinants, the validity of sick leave or work status as an outcome measure has been widely questioned (Bigos et al., 1991; Linton and Warg, 1993; Hazard et al., 1994; Dionne et al., 1999). The results on the sick leave parameter should therefore be interpreted with care.

Since the effect of Mensendieck exercises and education on low back pain has not previously been evaluated in a randomized controlled trial, a direct comparison of the results with other studies is impossible. In other studies reporting on exercises and education as secondary prevention of low back pain, patient characteristics, intervention length and content vary widely. Despite these differences, however, there is a similar trend across these studies. They all show significant effect of exercises and education up to one-year follow-up (Härkäpää et al., 1989; Linton et al., 1989; Donchin et al., 1990), with less favourable results in the

long term or at follow-up after more than one year (Härkäpää et al., 1990; Linton and Bradley, 1992).

There are limitations to the present study which should be noted. The non-blinded follow-up procedures and the use of self-reported data on recurrent low back pain, healthcare contacts and sick leave should indicate a careful interpretation of the results. Further, it would have been preferable to include other well-documented assessment instruments for studying low back pain (Roland and Morris, 1983; Baker et al., 1990), which could make comparison with other studies easier. In addition, more account should be taken of psychosocial variables related to work disability.

One practical problem in studies with long term follow-up is subjects who drop out of the study. In the present study, the Mensendieck group had more drop-outs than the control group. However, the total percentage of drop-outs at three-year follow-up (14%) can be compared to other long term studies (Härkäpää et al., 1990; Bendix et al., 1998). The baseline characteristics of the drop-outs (Table 2) are similar to those reported by Bendix and colleagues (1997, 1998) as well. Whether these characteristics comprise a subgroup of the low back pain population should be further investigated. Moreover, it is likely that other subgroups existed in the sample, which differed with regard to the benefit of the intervention. The sample size did not permit further subgroup analysis in the present study, but should be included in future clinical trials evaluating the effect of such interventions.

In summary, Mensendieck programmes are inexpensive, require minimal equipment and resources and are commonly used in Scandinavia and the Netherlands. This approach should be further investigated in a

larger study with careful attention to both the content and duration of the programme, as well as adherence to regular exercise.

## CONCLUSIONS

Twenty group sessions of Mensendieck exercises and ergonomical education significantly reduced the incidence of recurrent low back pain during a three-year period. The programme had no effect on sick leave, pain and function scores.

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## REFERENCES

- Altman DG. Practical Statistics for Medical Research. London: Chapman & Hall, 1991.
- Aubert AB. Extracts from the curriculum and the textbook of Mensendieck exercises. Oslo College: Faculty of Health Sciences, Mensendieck Physiotherapy, 1997.
- Baker DJ, Pynsent PB, Fairbank JCT. The Oswestry disability index revisited: its reliability, repeatability and validity, and a comparison with the St Thomas's disability index. In: MO Roland, JR Jenner (eds). New Approaches to Rehabilitation and Education. Manchester: Manchester University Press, 1990; 175-181.
- Battie MC, Bigos SJ. Industrial back pain complaints. A broader perspective. *Orthopedic Clinics of North America* 1991; 22: 273-282.
- Bendix AF, Bendix T, Lund PT, Kirkbak S, Ostensfeld S. Comparison of three intensive programs for chronic low back pain patients: a prospective randomized, observer-blinded study with one-year follow-up. *Scandinavian Journal of Rehabilitation Medicine* 1997; 29: 81-89.
- Bendix AF, Bendix T, Hastrup C, Busch E. A prospective, randomized 5-year follow-up study of functional restoration in chronic low back pain patients. *European Spine Journal* 1998; 7: 111-119.
- Bentsen BG, Natvig B, Winnem M. Vurdering av egen funksjonsevne. COOP-WONCAs spor-

- reskjemaer i klinikk og forskning. *Tidsskrift for den Norske Laegeforening (Journal of the Norwegian Medical Association)* 1997; 12: 1790-1793.
- Bigos SJ, Battie MC, Spengler DM, Fisher LD, Fordyce WE, Hansson TH et al. A prospective study of work perceptions and psychosocial factors affecting the report of back injury. *Spine* 1991; 16: 1-6.
- Butler DS. *Mobilisation of the Nervous System*. Melbourne: Churchill Livingstone, 1991; 139-143.
- Colton T. *Statistics in Medicine*. Boston, MA: Little, Brown & Co, 1974.
- Dionne CE, Von Korff M, Keopsell TD, Deyo RA, Barlow W, Checkoway H. A comparison of pain, functional limitations and work status as indices as outcome measures in back pain research. *Spine* 1999; 24: 2339-2345.
- Daltroy LH, Iversen MD, Larson MG, Lew R, Wright E, Ryan J et al. A controlled trial of an educational program to prevent low back injuries. *New England Journal of Medicine* 1997; 337: 322-328.
- Donchin M, Woolf O, Kaplan L, Floman Y. Secondary prevention of low back pain. A clinical trial. *Spine* 1990; 15: 1317-1320.
- Friedrich M, Gittler G, Halberstadt Y, Cermak T, Heiller I. Combined exercise and motivation program: effect on the compliance and level of disability of patients with chronic low back pain: a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation* 1998; 79: 475-487.
- Frost H, Moffett JK, Moser JS, Fairbank J. Randomised controlled trial for evaluation of fitness programme for patients with chronic low back pain. *British Medical Journal* 1995; 310: 151-154.
- Frost H, Lamb SE, Klaber MJ, Fairbank JC, Moser JS. A fitness programme for patients with chronic low back pain: 2-year follow-up of a randomised, controlled trial. *Pain* 1998; 75: 273-279.
- Härkäpää K, Järvikoski A, Mellin G, Hurri H. A controlled study on the outcome of inpatient and outpatient treatment of low back pain. *Scandinavian Journal of Rehabilitation Medicine* 1989; 21: 81-89.
- Härkäpää K, Mellin G, Järvikoski A, Hurri H. A controlled study on the outcome of inpatient and outpatient treatment of low back pain. Part III: Long-term follow-up of pain, disability and compliance. *Scandinavian Journal of Rehabilitation Medicine* 1990; 22: 181-188.
- Harreby G, Hesselsoe J, Kjer Neergaard K. Low back pain and physical exercise in leisure time in 38-year-old men and women: a 25-year prospective cohort study of 640 school children. *European Spine Journal* 1997; 6: 181-186.
- Hazard G, Haugh LG, Green PA, Jones PL. Chronic low back pain: the relationship between patient satisfaction and pain, impairment, and disability outcomes. *Spine* 1994; 19: 881-887.
- Heistaro S, Vartiainen E, Heliövaara M, Puska P. Trends of back pain in eastern Finland, 1972-1992, in relation to socioeconomic status and behavioral risk factors. *American Journal of Epidemiology* 1998; 147: 671-682.
- Heliövaara M. Risk factors for low back pain and sciatica. *Annals of Medicine* 1989; 21: 257-264.
- Huskisson EC. Measurement of pain. *Lancet* 1974; 2: 1127-1131.
- Jette AM, Delitto A. Physical therapy treatment choices for musculoskeletal impairments. *Physical Therapy* 1997; 77: 145-154.
- Jette AM, Smith K, Haley SM, Davis KD. Physical therapy episodes of care for patients with low back pain. *Physical Therapy* 1994; 74: 101-113.
- Johannsen F, Remvig L, Kryger P, Beck P, Warming S, Lybeck K, Dreyer V, Larsen LH. Exercises for chronic low back pain: a clinical trial. *Journal of Orthopedic and Sports Physical Therapy* 1995; 22: 52-59.
- Kellett KM, Kellett DA, Nordholm LA. Effects of an exercise program on sick leave due to back pain. *Physical Therapy* 1991; 71: 283-292.
- Kleinbaum DG, Kupper LL, Muller KE. *Applied Regression Analysis and Other Multivariate Methods*. Boston, MA: PWS-Kent Publishing Co, 1988.
- Larsen S, Aabakken L, Lillevold PE, Osnes M. Assessing soft data in clinical trials. *Pharmaceutical Medicine* 1991a; 5: 29-36.
- Larsen S, Sandvik L, Osnes M. The sample size in multicenter and stratified designed trials. *Pharmaceutical Medicine* 1991b; 5: 97-105.
- Lee ET. *Statistical Methods for Survival Data Analysis*. New York: John Wiley & Sons, 1992.
- Linton SJ, Bradley LA. An 18-month follow-up of a secondary prevention program for back pain: help and hindrance factors related to outcome maintenance. *Clinical Journal of Pain* 1992; 8: 227-236.
- Linton SJ, Warg LE. Attributions (beliefs) and job satisfaction associated with back pain in an industrial setting. *Perceptual and Motor Skills* 1993; 76: 51-62.
- Linton SJ, Bradley LA, Jensen I, Sprangfort E, Sundell L. The secondary prevention of low back pain: a controlled study with follow-up. *Pain* 1989; 36: 197-207.
- Mannion AF, Müntener M, Taimela S, Dvorak J. 1999 Volvo Award winner in clinical studies. A

- randomized clinical trial of three active therapies for chronic low back pain. *Spine* 1999; 24: 2435-2448.
- Moffatt KJ, Torgerson D, Bell-Syer S, Jackson D, Llewlyn-Phillips H, Farrin A et al. Randomised controlled trial of exercise for low back pain: clinical outcomes, costs, and preferences. *British Medical Journal* 1999; 319: 279-283.
- Riihimäki H, Tola S, Videman T, Hänninen K. Low back pain and occupation. A cross-sectional questionnaire study of men in machining operating, dynamic physical work, and sedentary work. *Spine* 1989; 14: 204-209.
- Roland M, Morris R. A study of the natural history of back pain. Part I: Development of a reliable and sensitive measure of disability in low back pain. *Spine* 1983; 8: 141-144.
- Scholten J, Van Weel C. Functional status assessment in family practice. The Dartmouth COOP Functional Health Assessment Charts/WONCA. Groningen: World Organization of Family Doctors 1992; 17-93.
- Slujis EM, Knibbe J. Patient compliance with exercise: different theoretical approaches to short-term and long-term compliance. *Patient Education and Counselling* 1991; 7: 191-204.
- Soukup MG, Glomsrød B, Lønn JH, Bø K, Larsen S. Effect of a Mensendieck exercise program as secondary prevention of low back pain. A randomized, controlled trial with 1-year follow-up. *Spine* 1999; 23: 1585-1591.
- Torstensen TA, Ljungren AE, Dyre Meen H, Odland E, Mowinckel P, af Geijerstam S. Efficiency and costs of medical exercise therapy, conventional physiotherapy, and self-exercise in patients with chronic low back pain. A pragmatic, randomized, single-blinded, controlled trial with 1-year follow-up. *Spine* 1998; 23: 2616-2624.
- van Tulder MV, Koes BA, Bouter LM. Conservative treatment of acute and chronic nonspecific low back pain. A systematic review of randomized controlled trials of the most common interventions. *Spine* 1997; 22: 2128-2156.
- Von Korff M, Deyo RA, Cherkin DC, Barlow W. Back pain in primary care: outcomes at 1 year. *Spine* 1993; 18: 855-862.

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