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Education by General Practitioners or Education and Exercises by Physiotherapists for Patients With Whiplash-Associated Disorders? A Randomized Clinical Trial

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Study Design. Randomized clinical trial.

Objective. To compare the effectiveness of education and advice given by general practitioners (GPs) with education, advice, and active exercise therapy given by physiotherapists (PTs) for patients with whiplash-associated disorders.

Summary of Background Data. Available evidence from systematic reviews has indicated beneficial effects for active interventions in patients with whiplash-associated disorders. However, it remained unclear which kind of active treatment was most effective.

Methods. Whiplash patients with symptoms or disabilities at 2 weeks after accident were recruited in primary care. Eligible patients still having symptoms or disabilities at 4 weeks were randomly allocated to GP care or physiotherapy. GPs and PTs treated patients according to a dynamic multimodal treatment protocol primarily aimed to increase activities and influence unfavorable psychosocial factors for recovery. We trained all health care providers about the characteristics of the whiplash problem, available evidence regarding prognosis and treatment, and protocol of the interventions. The content of the information provided to patients during treatment depended on the treatment goals set by the GPs or PTs. Also, the type of exercises chosen by the PTs depended on the treatment goals, and it was not explicitly necessary that exercise therapy was provided in all patients. Primary outcome measures included neck pain intensity, headache intensity, and work activities. Furthermore, an independent blinded assessor measured functional recovery, cervical range of motion, disability, housekeeping and social activities, fear of movement, coping, and general health status. We assessed outcomes at 8, 12, 26, and 52 weeks after the accident.

Results. A total of 80 patients were randomized to either GP care (n = 42) or physiotherapy (n = 38). At 12 and 52 weeks, no significant differences were found concerning the primary outcome measures. At 12 weeks, physiotherapy was significantly more effective than GP care for improving 1 of the measures of cervical range of motion (adjusted mean difference 12.3°; 95% confidence interval [CI] 2.7–21.9). Long-term differences between the groups favored GP care but were statistically significant only for some secondary outcome measures, including functional recovery (adjusted relative risk 2.3; 95% CI 1.0–5.0), coping (adjusted mean difference 1.7 points; 95% CI 0.2–3.3), and physical functioning (adjusted mean difference 8.9 points; 95% CI 0.6–17.2).

Conclusions. We found no significant differences for the primary outcome measures. Treatment by GPs and PTs were of similar effectiveness. The long-term effects of GP care seem to be better compared to physiotherapy for functional recovery, coping, and physical functioning. Physiotherapy seems to be more effective than GP care on cervical range of motion at short-term follow-up.

Key words: whiplash, randomized clinical trial, education, physiotherapy, general practitioner care, effectiveness.
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Whiplash injuries and, in particular, the development of chronic symptoms and disability are a clinical and social problem. To date, whiplash is usually defined as an acceleration-deceleration mechanism of energy transfer to the neck that results from rear-end or side-impact motor vehicle collisions, diving accidents, or other mishaps. The impact results in bony or soft tissue injuries (whiplash injury), which in turn may lead to a variety of clinical manifestations called whiplash-associated disorders (WAD).[1] The most commonly presented symptoms are neck pain and headache.[2] The majority of whiplash injuries are indicated as WAD grade 1 or 2. These patients have neck symptoms (grade 1) or neck symptoms with musculoskeletal signs (grade 2), which are usually being attributed to soft tissue injuries.

Reports on the course of WAD grades 1–2 show highly variable results. Most patients recover quickly and completely, but chronic symptoms or disability develop in a significant proportion (19% to 60%).[3,4] The

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evidence of effectiveness for conservative interventions is sparse.[5] The results of a systematic review on patients with WAD grades 1 and 2 revealed that active interventions, such as advice to "maintain usual activities" and multimodal treatment consisting of information, exercises, and mobilizations show beneficial effects on pain and disability, while rest and immobilization using collars did not.[5] However, there was a paucity of high-quality studies. Furthermore, the question remained as to which kind of active treatment is most effective. Therefore, we conducted a randomized clinical trial to compare the effect of active treatment consisting of education and advice given by general practitioners (GPs) and active treatment consisting of education, advice, and active exercise therapy given by physiotherapists (PTs) for patients with WAD grades 1 and 2.

■ Materials and Methods

A detailed description of the method is described elsewhere.[6]

Participants. In total, 122 GPs from urban practices and physicians from 3 Emergency Departments of hospitals in the middle and south of The Netherlands recruited patients from June 1999 to June 2002. The eligibility criteria were: acute WAD grade 1 or 2 as the result of a road-traffic accident, with symptoms like neck pain, headache, or dizziness within 48 hours after trauma; living in The Netherlands; and age between 18 and 55 years. Patients were excluded if they were diagnosed with a cervical hernia, past cervical spondylodesis, loss of consciousness, history of previous neck or head injury in the last 3 years, insufficient knowledge of the Dutch language to fill in questionnaires, or comorbidities. All potential participants were advised to "maintain usual activities" and "not to use a soft collar." Patients received standardized written and verbal information by the GP or emergency physician. If necessary, analgesics or nonsteroidal anti-inflammatory drugs were prescribed. Physiotherapy treatment or any other treatment was not allowed.

At 2 weeks after accident, the physicians of the research team assessed all potential participants and checked their eligibility. After a qualification period of 4 weeks, only those patients who were not functionally recovered (defined as still having symptoms or disabilities, or still using medication) were randomized and allocated to 1 of both interventions. The Dutch Advisory Committee on Ethics in Human Experimentation of Nijmegen and Tiel approved the study protocol.

Randomization. An independent researcher, not responsible for determining eligibility, performed the randomization using a computerized random-number generator (block size 4). Patients were prestratified for sampling frame (general practice or emergency department) and region (middle or south of the Netherlands). Allocation was concealed using opaque sealed envelopes. A blinded administrative assistant allocated patients by letter and telephone to their intervention. The administrative assistant was unaware of the randomization sequence and block size.

Blinding. Given the nature of the interventions, it was hard to blind patients and care providers. However, the exact content of treatments was not disclosed, thus, we might assume that patients were naive to the interventions. Blinded observers conducted outcome assessment. Success of blinding of the observers was evaluated using standardized questionnaires.

Interventions

Dynamic Treatment Protocol. PTs and GPs both treated the patients according to a dynamic biopsychosocial treatment protocol consisting of 4 different protocols using treatment goals and corresponding interventions.[6] Treatment was based on the patient's needs. All care providers received specific training programs to administer the treatment protocols.

Individual treatment started after randomization at 4 weeks after trauma. The maximum duration of the intervention period was 9 months. No maximum or minimum numbers of sessions were prescribed. Duration of treatment sessions lasted approximately 30 minutes for PT and 10 minutes for GP care. Treatment ended when the health problem was resolved or the treatment goals were reached. Treatment also ended when further treatment was not expected to produce positive results.

GP Care. GP care consisted of education and advice, including advice on graded activity. The kind of information given depended on the treatment goals chosen. Information consisted of the reassurance that there was no serious injury, importance of staying active and resuming activities as soon as possible, and expected prognosis.[7] The GPs explained to the patients that withdrawal from normal activities because of neck pain or failure to move the neck might lead to postural impairments with chronic complaints and that pain is not always a sign of tissue damage.[8,9] They also emphasized that using a soft collar and relying on medication rather than on activity might delay recovery.[5,9,10] Moreover, they encouraged patients to take responsibility for his or her health problem and decreased the focus on pain. Patients did not perform exercises at the GP practice. GPs primarily had a constructive and stimulating role.

Physiotherapy. PT intervention consisted of education, advice, graded activity, and exercise therapy. The content of the education and advice was similar to GP care. Patients performed graded activities at the PT practice, and PTs provided direct positive reinforcement to enhance patient's motivation and let patients experience that it was safe to move.[11] Exercise therapy included a broad scale of progressive loading exercises for cervical and shoulder muscle functions (stabilization, coordination, strength, endurance, length), articular functions (range of motion), posture, and balance. Functional activities such as carrying, lifting, pushing, and cycling were also trained using principles of graded activity.[11] Manual techniques such as passive cervical mobilizations were permitted, but not the first choice of treatment.

Contrast GP Care and Physiotherapy. Contrast between 2 intervention groups (GP *vs.* PT) was created by the profession of the care provider (GP *vs.* PT), duration of treatment session (10 *vs.* 30 minutes), and intervention possibilities, including education, advice, advice on graded activity by GPs *vs.* education, advice, graded activity, and exercise therapy by PTs.

Outcome Measurement. Primary outcome measures were neck pain, headache intensity, and work activities in daily living. Patients scored these outcomes on a visual analog scale (VAS). The VAS is regarded as a reliable, valid, and responsive assessment tool for pain[12,13] and functioning activities.[14,15] Secondary outcome measures included functional recovery

(VAS), general health status (Short Form-36), cervical range of motion (cervical range of motion device), fear of movement (Tampa Scale for Kinesiophobia), coping (Pain Coping Inventory), disability (Neck Disability Index), and disability in housekeeping and social activities (VAS).[6] Regular standardized training sessions for the blinded observers were organized to enhance the quality of measurements.

Baseline measurements were performed at 4 weeks after the accident at the end of the qualification period. Follow-up times to evaluate treatment were at 8, 12, 26, and 52 weeks after trauma. The main short-term follow-up was set at 12 weeks and the main long-term follow-up at 52 weeks. The VAS, cervical range of motion, and Tampa Scale for Kinesiophobia were assessed on location (*i.e.*, hospital). Patients completed all other outcome measures at home. At 52-week follow-up, patients received only postal questionnaires.

Sample Size. The study attempted to enroll 150 patients, with 75 per treatment group. This sample size is regarded sufficient to detect a difference of 20%, with a power of 0.8 and a 2-tailed significant level of 0.05, on the primary outcome measures (pain and work activities) between the GP and PT treatment. A difference of at least 20% was considered clinically relevant.

Statistical Analysis. Data of primary outcome measures were screened for normality, and, if necessary, we used nonparametric methods of analysis (Mann-Whitney U or χ^2 test). Effects of continuous outcomes (means with 95% confidence intervals [CIs]) were expressed as differences between baseline and 12, and 52 weeks, respectively (the mean improvement). We analyzed differences between the groups according to the "intention-to-treat" principle using SPSS (SPSS, Inc., Chicago, IL) for Windows (Microsoft, Corp., Redmond, WA) version 10.0 statistical software. All data of patients who withdrew from the trial were included in the analysis until the time of withdrawal, after which we used the group mean (continuous outcomes) or median (ordinal

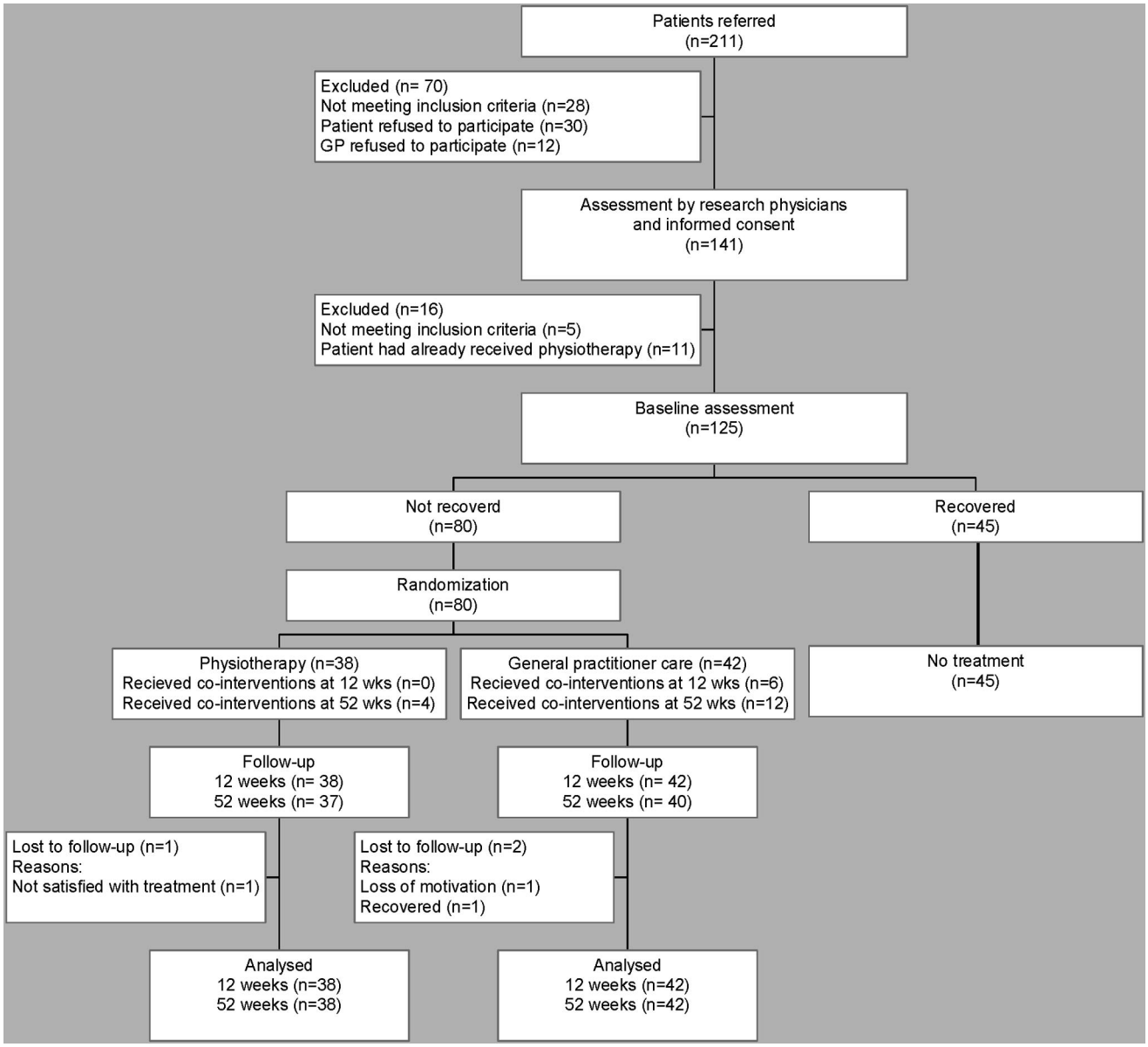

Figure 1. Flow diagram describing the progress of patients through the trial.

outcomes) to impute the missing data. Similarly, group means substituted occasional missing values.

Multiple linear regression analyses for continuous outcomes and Cox regression for dichotomous outcomes were conducted to adjust for differences between groups regarding potential confounding factors on the outcomes. In addition, we performed per protocol analysis excluding all patients receiving co-interventions and subgroup analyses for patients with high baseline neck pain or headache intensity. For all comparisons, a *P* value of 0.05 (2-tailed) was considered to indicate statistical significance.

■ Results

Participant Flow and Recruitment

In 3 years (June 1999–June 2002), GPs or emergency physicians recruited 211 of their patients, of whom 86 were excluded (Figure 1). A total of 45 patients were considered recovered within 4 weeks. Therefore, 80 patients were randomized to either GP (n = 42) or PT care (n = 38). All 80 patients (100%) completed the follow-up measurement for primary outcomes at 12 weeks and 77 (96%) at 52 weeks after trauma. Reasons for withdrawal were loss of motivation (n = 1), recovery (n = 1), or being dissatisfied with treatment (n = 1). The postal questionnaires for secondary outcomes of 6 patients, including 5 in the GP group and 1 in the PT group, were missing for all measurements, including baseline measurement, and these data were not substituted. Therefore, our analyses for secondary outcomes included 37 patients in the GP group and 37 patients in the PT group.

Baseline Data

Table 1 presents the baseline characteristics of the patient population. Mean age was approximately 32 years, and more than 60% were women. Despite randomization, there were some baseline differences between the groups with regard to neck pain intensity, work activities, gender, preexisting problems, and number of complaints.

Treatment

The mean number of treatment sessions for the GP group was 3.9 (±2.9), and mean treatment episode was 18.8 (±15.2) weeks. The mean number of treatment sessions in the PT group was 12.7 (±12.1), and treatment episode was 19.9 (±13.5) weeks. GP care was mainly aimed at reducing pain, increasing work activities, and decreasing distorted ways of thinking about pain. The main treatment goals in the PT group were reducing pain, improving cervical range of motion, muscle stability, and increasing work activities. None of the patients reported any adverse effects or side effects.

During the period of 1 year, the proportion of patients using medication was similar in both groups (54.8% in the GP group and 55.3% in the PT group). There were 5 patients (11.9%) in the GP group and 6 (15.8%) in the PT group who were referred for diagnostic measurements, such as computerized tomography, magnetic resonance imaging, or neurologic examination. Co-interventions such as manual therapy or psychologic treatment at 12 and 52 weeks (Table 2) were given significantly more often to patients allocated to GP care than to PT care (14.3% *vs.* 0%, 28.6% *vs.* 10.5%, respectively).

Table 1. Prognostic Factors and Baseline Values of Outcome Measures

	GP Care (n = 42)	Physiotherapy (n = 38)
Prognostic factors		
Mean age (SD)	33.8 ys (10.3)	31.9 ys (9.0)
No. women (%)	26 (61.9)	27 (71.1)
No. low education level (%)	12 (28.6)	11 (28.9)
No. middle education level (%)	20 (47.6)	15 (39.5)
No. high education level (%)	10 (23.8)	12 (31.6)
No. single (marital status)	10 (23.8%)	7 (18.4%)
No. preexisting problems (%)	11 (26.2)	15 (39.5)
No. seatbelt use (%)	33 (78.6)	29 (76.3)
No. head restraint (%)	39 (92.9)	33 (86.8)
No. unprepared for collision (%)	31 (73.8)	27 (71.1)
No. soft collar >3 ds (%)	5 (11.9)	3 (7.9)
No. high complaints (%)	18 (42.9)	13 (34.2)
No. radicular symptoms (%)	13 (31.0)	10 (26.3)
Primary outcome measures		
Mean VAS neck pain intensity (SD)	44.9 (26.6)	58.0 (21.1)
Mean VAS headache intensity (SD)	53.2 (30.3)	56.2 (31.5)
Mean VAS work activities (SD)	36.0 (34.5)	49.5 (35.3)
Secondary outcome measures		
Short-Form 36, general health status	50.7 (15.8)	49.9 (14.1)
Mean total cervical range of motion (SD)	267.8 (58.9)	255.5 (59.5)
Mean Tampa Scale for Kinesiophobia fear of movement (SD)	38.5 (5.9)	37.7 (7.6)
Mean Pain Coping Inventory Passive Coping (SD)*	40.2 (8.5)	41.8 (8.8)
Mean Neck Disability Index (SD)*	18.5 (9.1)	20.3 (7.0)
Median VAS housekeeping activities (interquartile range)	55.5 (30.3—88.8)	53.0 (26.8—83.3)
Median VAS social activities (interquartile range)	80.0 (49.8—96.8)	80.0 (55.5–95.0)
No. pain medication use (%)	15 (35.7)	15 (39.5)

*Postal questionnaires for 6 patients were missing, therefore there are 37 patients in the GP group and 37 in the PT group.
SD indicates standard deviation.

Evaluation of Blinding

For 82.5% of all patients (n = 80), the observers remained unaware of the allocated treatment. At 12 weeks,

Table 2. Number and Percentage of Patients Needing Co-Interventions at Different Follow-up Moments

	No. Allied Health Care (%)	No. Other (%)	No. Allied Health Care or Other (%)
GP care (n = 42)			
8 wks	1 (2.4)	3 (7.1)	4 (9.5)
12 wks	2 (4.8)	4 (9.5)	6 (14.3)
26 wks	4 (9.5)	3 (7.1)	7 (16.7)
52 wks	10 (23.8)	3 (7.1)	12 (28.6)
PT (n = 38)			
8 wks	0	1 (2.6)	1 (2.6)
12 wks	0	0	0
26 wks	3 (7.9)	2 (5.3)	3 (7.9)
52 wks	4 (10.5)	1 (2.6)	4 (10.5)

Allied health care includes physiotherapy, manual therapy, and exercise therapy according to Cesar or Mensendieck. Other treatment includes chiropractics, osteopathy, psychiatric treatment, and psychologic treatment. There was 1 patient in the GP and 2 patients in the PT groups who received allied health care and other treatment.

blinding was not successful in 5 patients, including 1 in the GP group and 4 in the PT group. These patients accidentally mentioned the allocated treatment. Median score on the VAS for blinding (0 mm: no idea of allocated treatment; 100 mm: allocated treatment known) was 3.8 (interquartile range = 2.0 to 22.5) in the GP group and 9.0 (interquartile range = 3.0 to 50.0) in the PT group. Thus, blinding could be considered successful.

Intention-To-Treat Analysis

Primary Outcome Measures. Table 3 shows the mean improvement in primary outcomes at different points of follow-up. Substantial improvement over time was observed in both treatment groups (Figures 2–4). There were no statistically significant differences between the groups at 12 weeks for all primary outcomes. At 52 weeks, patients who were treated by GPs scored significantly better on work activities compared to patients treated by PTs. Multivariate analysis showed that differences in baseline values of neck pain and work activities had important influences on the primary outcomes. The adjusted mean difference showed larger change scores on pain in favor of the GP group at 12 and 52 weeks of follow-up, however, still not significant. At 52 weeks, the improvement of neck pain intensity was more than 9.3 mm VAS for patients treated by GPs, and the improvement of headache was more than 13.0 mm VAS. In contrast, the adjusted mean differences for work activities were smaller and no longer statistically different after 52 weeks.

Secondary Outcome Measures. The mean improvements in secondary outcome measures are shown in Table 4. Physiotherapy scored better than GP care on cervical range of motion, although not all comparisons were statistically significant. The use of coping strategies (Pain Coping Inventory scales relaxation and resting) showed a significant difference in favor of GP care at 52 weeks. GP care also showed significantly better results for functional recovery, disabilities in housekeeping, and social activities. Some subscales of the SF-36, namely, physical functioning, social functioning, bodily pain, and general health, showed a significant difference in favor of GP care at both 12 and 52 weeks. Adjustment for likely confounding resulted in smaller differences between the intervention groups. Statistically significant differences were only found in favor of PT for cervical rotation at 12 weeks and in favor of GP care for functional recovery, coping strategy (relaxation and resting), physical functioning, and bodily pain (SF-36 scales) at 52 weeks. No significant differences were found for all other secondary outcome measures.

Table 3. Mean Improvement From Baseline in Primary Outcome Measures and Differences in Improvement Between GP and PT Care (intention-to-treat analysis)

Variable	No. Patients	General Practitioner Care (SD)	No. Patients	Physiotherapy (SD)	Mean Difference Between Groups (95% CI)	Adjusted Mean Difference (95% CI)*
Improvement in rating of severity, VAS (0–100)†						
Neck pain intensity						
8 wks since the accident	42	9.9 (28.2)	38	9.3 (21.4)	0.5 (−10.6 to 11.6)	6.1 (−4.5 to 16.8)
12 wks	42	13.2 (25.9)	38	23.3 (29.8)	−10.2 (−22.6 to 2.2)	1.7 (−9.3 to 12.7)
26 wks	42	22.5 (24.5)	38	18.7 (30.8)	3.8 (−8.5 to 16.1)	11.5 (−1.2 to 24.1)
52 wks	42	25.0 (24.7)	38	2.2 (29.5)	−0.2 (−12.2 to 11.9)	9.3 (−1.4 to 19.9)
Headache intensity						
8 wks since the accident	42	10.6 (31.3)	38	9.0 (28.6)	1.6 (−11.8 to 15.0)	1.9 (−12.7 to 16.6)
12 wks	42	21.9 (31.7)	38	19.1 (33.9)	2.8 (−11.8 to 17.4)	8.1 (−6.9 to 23.2)
26 wks	42	27.0 (29.8)	38	18.0 (40.0)	9.0 (−6.6 to 24.6)	11.2 (−6.1 to 28.5)
52 wks	42	32.7 (28.6)	38	21.2 (40.1)	11.5 (−4.0 to 26.9)	13.0 (−4.2 to 30.3)
Work activities						
8 wks since the accident	42	12.7 (35.2)	38	4.8 (26.0)	7.9 (−6.0 to 21.8)	4.0 (−11.0 to 18.9)
12 wks	42	22.1 (32.9)	38	13.3 (28.9)	8.8 (−5.0 to 22.7)	6.9 (−7.7 to 21.5)
26 wks	42	33.0 (42.5)	38	17.1 (34.7)	15.9 (−1.5 to 33.3)	6.3 (−10.6 to 23.2)
52 wks	42	46.3 (36.5)	38	22.8 (34.6)	23.5 (7.6 to 39.3)‡	11.3 (−1.0 to 23.7)

*Adjusted for neck pain intensity, work activities, gender, preexisting problems, and high number of complaints.
†Pain rated on a VAS, with 100 indicating very severe pain. Work activities rated on a VAS, with 100 indicating no disabilities in work.
‡$P \leq 0.01$.
SD indicates standard deviation.

Figure 2. Mean neck pain scores during follow-up in patients with WAD.

Subgroup Analysis

We conducted subgroup analyses to investigate whether treatment effects depended on severity of neck pain or headache at baseline. The results showed that in patients with initial neck pain intensity (>75 mm on VAS), PT was significantly more effective on neck pain than GP care at 12 weeks ($P = 0.013$; mean difference 40.4 mm VAS; 95% CI 11.1–69.7). In patients with high initial headache intensity (>75 mm VAS), long-term effects of GP care were larger for neck pain ($P = 0.03$; mean difference 24.7 mm VAS; 95% CI 2.6–46.9) and work activities ($P = 0.02$; mean difference 39.5 mm VAS; 95% CI 8.4–70.6).

Per Protocol Analysis

We performed a per protocol analysis excluding patients who received co-interventions (*e.g.*, manual therapy, physiotherapy, psychologic treatment). The unadjusted and adjusted results for the primary outcome measures were similar to those of the intention-to-treat analysis, with 1 exception. There was a significant reduction in neck pain at 26 weeks for patients treated by GPs when compared to PTs (adjusted mean difference 15.4; 95% CI 1.9–28.9). No significant differences were found for headache or work activities.

■ Discussion

This randomized trial in primary care shows no significant differences between enhanced GP and PT care on our primary outcome measures. Nevertheless, PT care seems to have more effect than GP care for patients with WAD on cervical range of motion at short-term follow-up. In the long-term, GP care is more effective than PT care in terms of functional recovery, coping, and physical functioning. Excluding patients who received co-interventions yielded similar results as our intention-to-treat analyses, which indicates that protocol deviations did not bias our results.

We need to be careful when drawing conclusions based on our study for several reasons. First, high initial pain intensity and work disability were important confounders in our study. Previous studies have also shown that high initial pain intensity is an important predictor of delayed recovery.[16,17] The PT group had higher scores for neck pain at baseline and, therefore, more scope for improvement compared to the GP group. The PT group also had higher scores at baseline for work activities (*i.e.*, were more active), which means that there was less scope for improvement on this outcome measure compared to the GP group. In this situation, adjustment for differences between groups in baseline values is necessary to prevent the effects of regression to the mean. The adjusted analysis produced larger differences between the groups in favor of GP care with respect to pain but smaller differences with respect to work disability. None of these differences were statistically significant.

Second, recruitment of participants was much slower than expected, and we failed to achieve our original target sample size. This size may have influenced the generalizability of our results and has limited the statistical power of our study. Various measures, including newsletters, clinical meetings, telephone calls, small incentives, and expansion of recruitment period and region, were undertaken to motivate the participating physicians and enhance recruitment. The main reasons for not referring patients were busy office hours, forgetfulness, and the strict inclusion criteria. Therefore, we believe that the external validity of our trial has not been substantially threatened by inadequate patient referral. With respect to statistical power of the trial, most

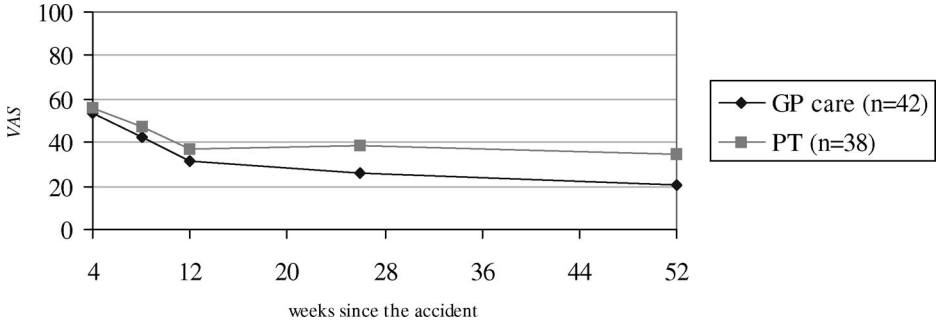

Figure 3. Mean headache scores during follow-up in patients with WAD.

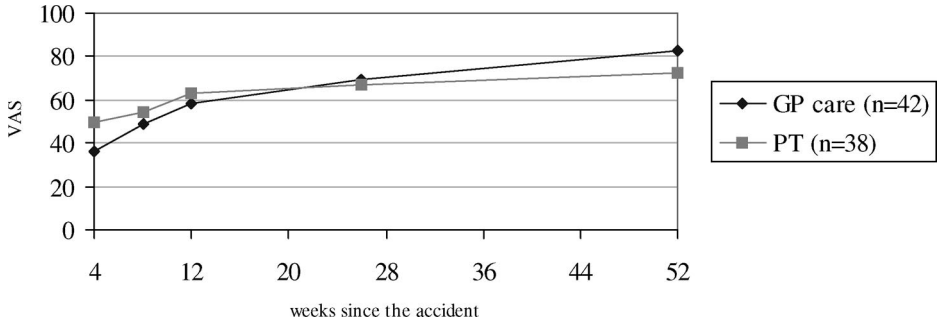

Figure 4. Mean work activity scores during follow-up in patients with WAD.

differences between groups were not statistically significant. When viewing our primary outcomes more closely, the adjusted mean differences between groups varied between 9 and 13 mm VAS at 52-week follow-up. Considering baseline values (between 45 and 58 mm on a VAS), this means a difference in improvement of approximately 20%. This difference is considered clinically important[18] and was the basis of the power calculation of our trial. With a larger sample size, we could have achieved statistical significance for these relevant differences on our other primary outcomes.

Table 4. Mean Improvement From Baseline in Secondary Outcome Measures and Differences in Improvement Between GP and PT Care (intention-to-treat analysis)

Variable	No. Patients	General Practitioner Care (SD)	No. Patients	Physiotherapy (SD)	Mean Difference Between Groups (95% CI)	Adjusted Mean Difference (95% CI)*
Improvement in cervical range of motion (degrees)						
Lateroflexion						
12 wks since the accident	42	7.1 (12.2)	38	11.1 (13.5)	−4.0 (−9.7 to 1.7)	−4.9 (−10.8 to 1.1)
26 wks	42	7.6 (13.7)	38	10.5 (17.4)	−2.9 (−9.9 to 4.0)	−3.2 (−10.9 to 4.5)
Rotation						
12 wks since the accident	42	5.5 (20.0)	38	18.4 (19.5)	−12.9 (−21.8 to −4.1)†	−12.3 (−21.9 to −2.7)‡
26 wks	42	8.4 (26.3)	38	20.5 (25.2)	−12.1 (−23.6 to −0.6)‡	−9.5 (−22.0 to 3.0)
Flexion-extension						
12 wks since the accident	42	11.1 (20.3)	38	13.7 (22.1)	−2.6 (−12.1 to 6.8)	−1.9 (−12.1 to 8.3)
26 wks	42	14.6 (26.7)	38	21.1 (25.9)	−6.5 (−18.2 to 5.2)	−5.1 (−17.9 to 7.8)
Total range of motion						
12 wks since the accident	42	23.6 (44.7)	38	43.2 (47.0)	−19.6 (−40.0 to 0.8)	−19.0 (−40.8 to 2.7)
26 wks	42	30.6 (60.3)	38	51.9 (59.6)	−21.3 (−48.0 to 5.5)	−18.3 (−47.3 to 10.8)
Improvement in fear of movement (Tampa Scale for Kinesiophobia 17–68)						
12 wks since the accident	42	4.5 (7.6)	38	4.2 (7.3)	0.3 (−3.0 to 3.6)	0.8 (−2.7 to 4.4)
52 wks	42	5.7 (6.5)	38	6.7 (6.3)	−1.0 (−3.9 to 1.8)	−1.4 (−4.5 to 1.7)
Improvement in disability (Neck Disability Index 0–50)						
12 wks since the accident	37	5.2 (6.6)	38	5.3 (6.8)	−0.1 (−3.1 to 3.0)	−0.3 (−3.5 to 3.1)
52 wks	37	8.4 (7.4)	38	6.8 (6.2)	1.9 (−1.2 to 5.1)	2.0 (−1.1 to 5.1)
Improvement in housekeeping activities (VAS 0–100)						
12 wks since the accident	42	15.3 (27.7)	38	10.2 (28.9)	5.1 (−8.6 to 18.8)	−0.3 (−13.3 to 14.0)
52 wks	42	24.9 (24.9)	38	12.0 (28.7)	12.9 (0.2 to 25.6)‡	7.1 (−4.2 to 18.4)
Improvement in social activities (VAS 0–100)						
12 wks since the accident	42	13.3 (25.1)	38	1.2 (21.1)	12.1 (1.5 to 22.6)‡	8.6 (−2.7 to 19.9)
52 wks	42	19.9 (28.6)	38	7.2 (18.2)	12.7 (1.9 to 23.5)‡	7.8 (−3.6 to 19.3)
Improvement in general health, total score (SF-36 0–100)						
12 wks since the accident	38	14.7 (14.1)	38	9.0 (15.3)	5.7 (−1.1 to 12.4)	6.3 (−0.8 to 13.5)
52 wks	38	22.9 (13.3)	37	17.0 (17.7)	5.9 (−1.3 to 13.1)	4.0 (−3.8 to 1.9)
Improvement in coping strategy, Pain Coping Inventory						
Passive coping						
12 wks since the accident	37	4.0 (9.2)	37	3.1 (7.4)	0.8 (−3.1 to 4.7)	−0.1 (−4.3 to 4.2)
52 wks	37	6.8 (8.4)	37	4.2 (8.4)	2.6 (−1.4 to 6.5)	1.8 (−2.4 to 5.9)
		No. (%)		No. (%)	RR (95% CI)	Adjusted RR (95% CI)
No. of patients functionally recovered (%)						
12 wks since the accident	42	18 (42.9)	38	13 (34.2)	1.3 (0.6 to 2.6)	1.4 (0.6 to 3.0)
52 wks	42	25 (59.5)	38	11 (28.9)†	2.1 (1.0 to 4.2)‡	2.3 (1.0 to 5.0)‡

Cervical range of motion was measured with a cervical range of motion device. Fear of movement was rated on the Tampa Scale for Kinesiophobia (17–68), with 68 indicating very severe fear of movement. Disability was rated on the Neck Disability Index (0–50), with 50 indicating very severe disability. Housekeeping and social activities were rated on a VAS (0–100), with 100 indicating no disabilities. General health was rated on the Short Form-36 (0–100), with 100 indicating very well quality of life. Coping strategy was rated on the Pain Coping Inventory, with a higher score meaning a more frequent use of the coping strategy. Functional recovery was defined as no or less symptoms or disabilities without medication use, and it is measured on a standardized questionnaire.

*Adjusted for neck pain intensity, work activities, gender, preexisting problems, and high number of complaints.

†$P \leq 0.01$.

‡$P \leq 0.05$.

RR indicates relative risk; SD, standard deviation.

A large number of outcome measures were included in our study. This number was important to study the impact of our multimodal intervention on biologic, psychologic, and social measures of health.[19] However, the large number of tests may have produced spurious results (chance findings) caused by multiple testing. Therefore, it is important to put more emphasis on the magnitude and direction of our results than on statistical significance.

The results (adjusted mean differences) were consistent across most outcome measures, with increasing effects on primary outcomes in favor of GP care and beneficial short-term effects in favor of PT care for measures of spinal mobility. The results of our subgroup analyses also need to be interpreted with caution. Because of the small number of patients, it was not possible to adjust for confounding, and the risk of chance findings is higher. However, the results of the subgroup analyses confirmed assumptions made before the start of the study, emphasizing the potential influence of baseline pain levels on the effects of treatment.

Loss to follow-up was minimized by adequately informing patients before enrolment, sending letters before each appointment at the research center, sending birthday cards, reimbursing traveling expenses, and a book token when patients had attended all measurements. We may assume that these measures have been effective because of the small number of those patients lost to follow-up. Our study implicates that GP care consisting of specific education and advice is a favorable treatment option in the long term for patients with WAD grade 1 or 2. GP care consisted of several consultations, with detailed education and advice aimed at reassurance and reactivation, which cannot be considered as "usual care" for GPs in The Netherlands. GPs were trained to administer the treatment protocols, and obtained more knowledge on whiplash and its treatment, which may limit the generalizability of the results of our trial. To optimize implementation of this treatment strategy, we believe that specific courses on whiplash and its treatment should be provided for all GPs.

PT treatment was generally consistent with the Dutch physiotherapy guidelines for whiplash.[20,21] The guidelines have recently been issued, and it is questionable to what extent the guidelines are implemented in daily practice. While evaluating the PT treatment in our trial, we would like to stress the importance of providing education and advice instead of relying on improving functions, such as cervical mobility or muscular stability. In this study, improvements in functions had little effect on pain or activities. Although changes are being made in the counseling training of PTs, as yet, PTs are generally trained to treat functions. Patients also expect PTs to perform hands-on treatment, such as massage and passive mobilizations, which may partly explain the fact that PTs mainly impacted functions, and not on psychosocial measures, such as cognition or coping. More training will be needed to achieve effective implementation of active treatment strategies for whiplash in physiotherapy practice.

This trial was not placebo controlled and did not contain a no-treatment control group; therefore, no conclusions can be drawn regarding the overall effectiveness of treatment. Our study can only support conclusions based on the relative differences between 2 active treatment groups and cannot show to what extent treatment has improved the natural course of whiplash. We did not perform a cost-effectiveness analysis because insufficient reliable data were available regarding some aspects of direct medical costs, and regarding the indirect costs associated with sickness absenteeism and loss of productivity. However, when looking at information about the direct costs of GP and PT care (*e.g.,* number of treatment sessions and duration of sessions), and the level of performing work activities in both groups, we may expect that GP care is more cost effective than PT care.

To our knowledge, no previous trials in the literature are comparable with our study in which we compared 2 different active interventions for whiplash provided by different care providers. We found 1 article that presented the design of a randomized controlled trial examining the effects of advice and an individualized submaximal exercise program under supervision from PTs for patients with chronic WAD.[22] These results are not yet available. The proportion of recovered patients in this study is somewhat lower than in other studies.[4,23,24] This lower proportion could be explained by the type of patients chosen. We only included whiplash patients who still had symptoms or restrictions in work-related activities at 4 weeks after trauma, and these could be regarded as the patients with a poor prognosis, having a lower chance for recovery. Moreover, the definition of recovery in our study was quite strict compared to other studies. Future studies, well designed and of sufficient size should focus on patients at risk for delayed recovery (*e.g.*, patients with high initial pain levels). Such studies should further establish the effectiveness and cost-effectiveness of active treatment strategies for WAD in primary care. In conclusion, physiotherapy and "enhanced" GP care were of similar effectiveness in the treatment of patients with WAD grade 1 and 2.

■ Key Points

- Systematic reviews have indicated that active treatments have beneficial effects for patients with WAD grades 1 and 2. However, it remained unclear which active treatments were most effective.
- No significant differences were found between education given by GPs and education and active exercises given by PTs for the primary outcome measures.
- Physiotherapy seems to be more effective than GP care on cervical range of motion at short-term follow-up.
- The long-term effects of GP care seem to be better than physiotherapy for some secondary outcomes, including functional recovery, coping, and physical functioning.

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