General Section
Research Paper

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PAIN REPORTS®

Multidimensional health changes after a multimodal pain rehabilitation program: a registry-based study

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Abstract

Introduction: Chronic pain is treated with multimodal rehabilitation programs, targeting improvement in several health aspects. These treatments must be evaluated multidimensionally, which is a methodological challenge.
Objectives: This study investigated factors (demographic, pain-related, and individual- vs group-based treatment) predicting successful outcomes after multimodal pain rehabilitation programs.
Methods: Data from 3 outpatient clinics were retrieved from the Swedish Quality Registry for Pain Rehabilitation, for 314 patients (218 women). Outcome variables were dichotomized as binary change (improved or not improved) based on clinical thresholds. Total improvement grouped outcomes into 0 to 2, 3 to 4, and 5 to 6 improved variables. Binary logistic regression analyses investigated the association between the baseline predictors and change variables.
Results: Patients improving after treatment ranged from 34% (pain intensity) to 80% (depression) for women and 34% to 76% for men, respectively. Total improvement outcome was consistent (after treatment and 1 year) with 28% of patients improving on 5 to 6 outcomes. The baseline predictor related to most improved outcomes was pain intensity, with positive correlation to improvement in pain intensity ($P < 0.001$) and negative correlation with improvements in anxiety ($P = 0.075$) and depression ($P = 0.002$). Individual-based treatment, compared with group-based treatment, was associated with improvement in pain intensity ($P = 0.008$).
Conclusions: About a third of patients improved in several outcomes by the end of a multimodal program, with most improvement for depression and least for pain intensity. Generally, patients with more severe health status at baseline improve most directly after treatment, but these findings could not suggest treatment adjustments that would improve overall success rates.

Keywords: Chronic pain, Multimodal pain rehabilitation, Epidemiology

1. Introduction

Chronic pain confers a substantial burden on individuals, employers, health care systems, and society in general. In severe cases, it is a complex and multidimensional disease. A biopsychosocial treatment approach is common in pain rehabilitation programs at the medical specialist level, commonly called multimodal pain rehabilitation programs.[21] These multimodal and interdisciplinary treatment schemes are based on a cognitive-behavioral therapy approach in combination with sessions of pain education, physical activity and exercise, and occupational therapy. The interdisciplinary teams usually include physicians, psychologists, physiotherapists, occupational therapists, and other health professionals.[11,18]

Because the treatment is multimodal, it targets improvement in several different health aspects, such as physical function, mental well-being, and the pain itself. Because of this, treatment effect must be evaluated multidimensionally, which is a methodological challenge. For general groups of patients with chronic pain, little is

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.painrpts.com).

PR9 6 (2021) e938

http://dx.doi.org/10.1097/PR9.0000000000000938

known about factors that influence successful outcomes of pain programs.[16] Studies commonly consider only single outcome aspects.[24] Moreover, there are few health economic evaluations of such programs with acceptable quality.[23] A 2006 report from the Swedish Council on Technology Assessment in Health Care[20] highlights the need for research comparing the effectiveness of multimodal pain programs between patients with various degrees of generalized pain, investigating the effect of different components in multimodal pain programs, and examining the specific needs in groups with non-Swedish background.

Multimodal pain programs, like many other treatment schemes, are known to have an effect on the group level, but effects are heterogeneous for different individuals.[17] The need for studies identifying effect heterogeneity over the patient group has been emphasized.[20]

The main aim of this study was to investigate general groups of patients with chronic pain to identify inhibitory and facilitating factors for successful outcomes from existing pain programs, both for the patient (demographics and pain-related aspects) and regarding components in the pain programs (group-based vs solely individual treatment components).

Specific research aims were

(1) To describe the pattern of changes from baseline to the end of the program.
(2) To identify inhibitory and facilitating factors for successful pain program outcomes regarding function, pain intensity, and sick listing, for demographics and pain-related aspects.
(3) To investigate whether the outcomes of individual programs and programs with group-based components differ for function, pain intensity, or sick listing.

2. Materials and methods

In this retrospective study, data from 3 outpatient pain clinics were retrieved from the Swedish Quality Registry for Pain Rehabilitation (SQRP, Nationella Registret för Smärtrehabilitering). Included in the study were patients between January 2013 and December 2016 who were selected to attend a pain rehabilitation program. We retrieved registry data for 314 patients (218 women and 96 men).

The pain rehabilitation programs in all 3 of the care units offered multimodal interventions based on cognitive-behavioral principles in an outpatient setting. The patients were offered daily rehabilitation in Monday through Friday programs or programs covering various parts of a week. In addition, home exercises were added. In 2 care units, the programs included a combination of individual- and group-based therapies, where group size varied from 8 to 20 patients. The third care unit had only individual programs with no group sessions.

The teams of all care units included at least a physician, occupational therapist, physiotherapist, psychologist, and social worker. Program content included physical and occupational therapy, medical pain management, vocational rehabilitation, relaxation techniques, body awareness, fitness training, mindfulness, and counseling.

At the beginning of the program, all teams formulated rehabilitation plans for their patients to address specific problem areas. They worked with a self-management perspective and a functional restorative approach, with the goal of regaining an active life and facilitating return to work. All the pain programs shared a goal of combating the consequences of pain rather than pain itself and were designed to enhance each patient's understanding of chronic pain conditions. Patient education was delivered in the form of a "pain school" consisting of lectures and group discussions covering topics such as pain mechanisms, pain psychology, and pain physiology.

Data for 3 time points were available (1) at the first visit at the clinic, (2) at the end of the pain program, and (3) a year after the end of the pain program. At some clinics, the first visit was also the start of the multimodal program, while at others, these occurred at 2 different times. See flowchart in **Figure 1**. Owing to many missing values, the results from the 1-year follow-up should be interpreted with caution.

The baseline factors investigated were age, sex, birth origin (Nordic or non-Nordic country), education (1 = primary school, 2 = secondary school, and 3 = university), pain intensity measured on a Numeric Rating Scale (NRS),[8] pain spread (number of marked pain sites), pain duration (in months) and frequency (regular or periodic pain), physical function, social function, and vitality measured using the 36-Item Short-Form Survey (SF-36),[6,22] and anxiety and depression measured using the Hospital Anxiety and Depression Scale.[15] In the second step, the individual program (care unit 3 in **Table 1**) and the 2 programs with group-based components (care units 1 and 2 in **Table 1**) were compared using the variable individual program.

The 2 types of outcome variables used were *binary change* and *total improvement*. These were based on changes between baseline and the end of the treatment for 6 different patient-reported outcomes: pain intensity on the NRS, with the minimal important difference (MID) set to 2 steps on the scale[8]; the SF-36 domains physical function, social function, and vitality, with the MID set to 5 units[2]; and HAD anxiety and HAD depression, with the MID set to 1.7 units.[15] The smallest possible change in sick listing was 25% units, and this was defined as an important change.

Binary change was defined as the change dichotomized into *improved* and *not improved*. For the anxiety and depression variables, *improved* included both those who improved and those who began at a favorable level (≤7) and remained there (unchanged positive). The category *not improved* included both those who began on an unfavorable level (>7) and did not improve (unchanged negative) and those who worsened. A similar definition was used for sick

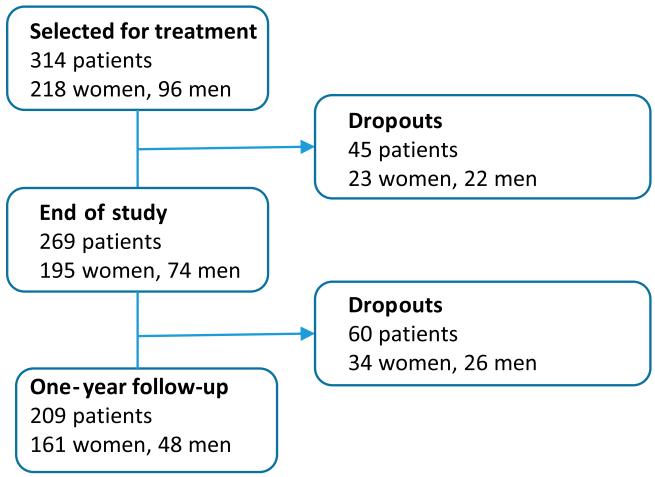

Figure 1. Flow chart showing the data retrieved from the registry and dropout between the different time points. Dropout could be due to several reasons, eg, patient's own choice not to participate or practical obstacles for the patient to attend.

Table 1

Baseline description of patients stratified by sex and by the 3 care units.

Variables at baseline	Women						Men					
	Unit 1, 68%, n = 118		Unit 2, 72%, n = 33		Unit 3, 71%, n = 67		Unit 1, 32%, n = 56		Unit 2, 28%, n = 13		Unit 3, 29%, n = 27	
	%	n	%	n	%	n	%	n	%	n	%	n
Education												
Primary school	16%	17	27.3%	9	8%	5	17%	9	27.27%	3	12.5%	3
Upper secondary school	56%	61	48.5%	16	48%	29	72%	39	54.55%	6	70.8%	17
University	28%	31	24.2%	8	43%	26	11%	6	18.18%	2	16.7%	4
Nordic origin (ref: non-Nordic)	85%	99	91%	30	78%	51	84%	47	82%	9	81%	22
Persistent pain (ref: periodic)	94%	110	88%	28	80%	52	88%	49	91%	10	74%	20
Widespread pain (ACR) (ref: local or regional pain)	89%	104	91%	30	75%	55	75%	32	91%	10	59%	6
Total sickness benefits 75–100% (ref: 0–50%)	57%	64	55%	17	24%	14	59%	32	54%	6	28%	7

First row: unit 1 Second row: unit 2 Third row: unit 3	Min	Median	Max	Min	Median	Max
Age	17	46	71	19	42	64
	19	43	62	33	49	58
	17	40	69	22	41	59
Pain sites (0–36)	0*	14	36	1	10	34
	2	14	29	0†	8	32
	0‡	9	34	1	7	36
Pain duration (mo)	7	74	406	7	40	345
	7	64	464	8	54	434
	2	60	383	5	27	370
Pain intensity (NRS)	3	7	10	2	7	10
	3	7	10	6	7	9
	1	7	10	1	6	10
Not improvable	0% (n = 0)			0% (n = 0)		
Physical function	5	50	100	5	58	100
	10	60	90	20	55	95
	15	65	100	17	70	90
Not improvable	2% (n = 5)			1% (n = 1)		
Social function	0	50	100	0	38	100
	0	50	100	25	50	100
	0	50	100	13	50	100
Not improvable	8% (n = 16)			5% (n = 5)		
Vitality	0	20	85	0	20	70
	0	25	80	0	25	80
	0	25	90	5	38	60
Not improvable	0% (n = 0)			0% (n = 0)		
Anxiety (HADS)	0	10	20	2	9	18
	3	9	19	0	10	16
	1	9	19	9	5	17
Not improvable	2% (n = 5)			2% (n = 2)		
Depression (HADS)	0	9	21	1	9	20
	1	8	21	2	9.5	18
	0	8	17	0	6	18
Not improvable	2% (n = 4)			2% (n = 2)		

* One individual with *ICD-10* code R522: other chronic pain.

† Two individuals with *ICD-10* code M792: neuralgia and neuritis, unspecified.

‡ Two individuals, both with *ICD-10* code M791: fibromyalgia and with an additional diagnosis at the end of the program, G560: carpal tunnel syndrome in 1 individual, and R522: other chronic pain in the other individual. This does not explain why they did not mark any regions of pain on the manikin.

ACR, American College of Rheumatology; HADS, Hospital Anxiety and Depression Scale; NRS, Numeric Rating Scale.

listing, where the favorable level was set to ≤25% and an unfavorable level was set to ≥50%. There are no well-defined clinical thresholds for favorable levels of the other 4 variables (pain intensity, physical function, social function, and vitality), and so, for these variables, *improved* included only those who improved, and *not improved* included both those who remained unchanged and those who worsened.

Total improvement was defined as follows: 0 = 0 to 2 improved variables, 1 = 3 to 4 improved variables, and 2 = 5 to 6 improved variables.

3. Statistical analysis

Categorical variables at baseline were described as proportions of responders in different categories. For continuous variables, or variables treated as continuous, we calculated minimum and maximum values together with quantiles at baseline.

Changes from baseline to end of treatment, respectively, the 1-year follow-up, were described with percentages of responders in the categories *improved* and *not improved*, respectively, in the different categories of the *total improvement* variable. We also

calculated 95% confidence intervals in **Table 3** based on the Wilson method[25] for percentages.

Patterns in the change variables were investigated through a principal component analysis (PCA) for *binary change* variables, based on the correlation matrix and with varimax rotation. For further investigation of the relationship between the different change variables, we performed a mixed effects logistic regression, where the different *binary change*s were seen as repeated measures of a global change. This is closely related to the concept of Rasch analysis.[19]

Binary logistic regression analyses were used to investigate the association between the baseline predictors and the change variables. For each of the 6 outcomes, we first performed logistic regression analysis with only 1 predictor at a time. All the predictors with $P \leq 0.25$ in these analyses were included in a multiple model. The predictors that had $P \leq 0.25$ in the multiple model were then deleted one at a time, starting with the predictor with the highest *P*-value. This technique has been described as purposeful model building.[7] When analyzing the overall outcome, *total improvement*, we used a similar procedure based on a multinomial logistic regression. The check for collinearity showed no problems between the baseline factors of interest.

The predictions based on the logistic regression models were evaluated based on sensitivity, specificity, and the likelihood ratios; LR+ = sensitivity/(1 − specificity) and LR− = (1 − sensitivity)/specificity. If the likelihood ratio is greater than 1, the test result is indicated to be associated with the event. If the likelihood ratio is less than 1, the test result is associated with the absence of the event. If the likelihood ratio is close to 1, the test has low predictive quality.[1] One way to interpret LR+ is that values of about 5 indicate a moderate increase of the probability of having the event after receiving a positive test; values of about 2 indicate only a slight increase in the probability of the event. Similarly for LR−, values of about 0.2 indicate a moderate decrease in the probability of the event if receiving a positive test, and values around 0.5 indicate a slight decrease.[14]

4. Results

4.1. Baseline description

Table 1 shows descriptive statistics for the 3 care units separately. From this, we can see that most patients had widespread pain according to the American College of Rheumatology definition. Only 4 patients in total had local pain (single site). Most patients had persistent pain, and the median pain intensity was 7 on the NRS (a scale ranging from zero to 10).

4.2. Description of the change in outcomes

The proportion of patients improving after treatment ranged from 34% (pain intensity) to 80% (depression) among women and from 37% (pain intensity) to 76% (depression) among men (**Fig. 2**).

The proportion of patients improving at 1-year follow-up ranged from 34% (pain intensity) to 72% (anxiety) among women and from 42% (sick listing) to 67% (anxiety) among men (**Fig. 2**). For men, pain intensity still had the second lowest proportion of improvement, 44%.

The PCA for the change from baseline to end of treatment and the 1-year follow-up, respectively, revealed 2 dimensions; the first dimension included pain intensity and physical function, and vitality, while the second dimension included anxiety and depression, and social function (**Table 2**). As a sensitivity analysis, we also performed PCA on the original changes, calculated as the differences between end of treatment and baseline. The results were very similar, with the only difference being a switch in order of the 2 dimensions.

According to the descriptive statistics for the *total improvement* outcome variable, the proportion of patients in different categories did not clearly differ between men and women (**Table 3**). The *total improvement* was also similar between baseline and after treatment, respectively, after 1 year.

Figure 3 shows the order of the outcomes according to their probability of improvement and is based on a mixed effects logistic regression (random intercept alone). One could interpret this as a lowest probability of improvement or lowest success probability for the outcome pain intensity. The other outcomes, in increasing order, are social function, physical function, vitality, anxiety, and depression. Hence, depression seemed to be the outcome with the highest probability of success in general.

4.3. Associations between improvement in outcome and baseline predictors

Tables with *P*-values for the association between 1 predictor at a time and the different outcomes are presented in **Table 4** for the results for improvement between baseline and after treatment. The final multiple models are presented in **Table 5**. The baseline predictor related to most of the improvements was pain intensity. It was positively associated with improvement of pain intensity and negatively associated with improvements in anxiety and depression. In the 1-year follow-up analysis, pain intensity was still a predictor for improvement in pain intensity but not a statistically significant predictor for depression or anxiety (Supplementary Table S1a and Table S1b, available at http://links.lww.com/PR9/A110).

Both the positive and negative likelihood ratios (LR+ and LR−) were close to one for improved physical function and social function, which indicated that a positive test does not give us any additional information on the probability of improvement compared with the descriptive information based on the prevalence of improvement in the patient population. For vitality, LR−was slightly smaller than 1, indicating that a negative test has some, even if small, predictive power. For decreased pain intensity and *total improvement*, LR + varied between 2 and 3.8, indicating that a positive test may have some, even if small, predictive power (**Table 5**). For these 2 outcomes, predictors of interest were social function and vitality, respectively, pain duration, pain intensity, and individual only treatment.

In the 1-year follow-up analysis, the LR+ was equal to 2.2 for decreased pain intensity, indicating that a positive test may have some, even if small, predictive power. Predictors of interest were pain intensity and vitality. In the 1-year follow-up data, decreased sick listing was also analyzed. Predictors were woman, constant pain, and pain duration. Individual only treatment also had a tendency of association, although the likelihood ratios were close to one.

Full results can be viewed in the Supplementary Tables S1a and S1b (available at http://links.lww.com/PR9/A110).

5. Discussion and conclusions

Using register data from multimodal pain rehabilitation programs, this study investigated factors related to positive and negative outcomes for individuals with chronic pain. We found that improvements in pain intensity and physical function were correlated, as well as changes in anxiety and depression. For improvement at the end of the treatment, pain

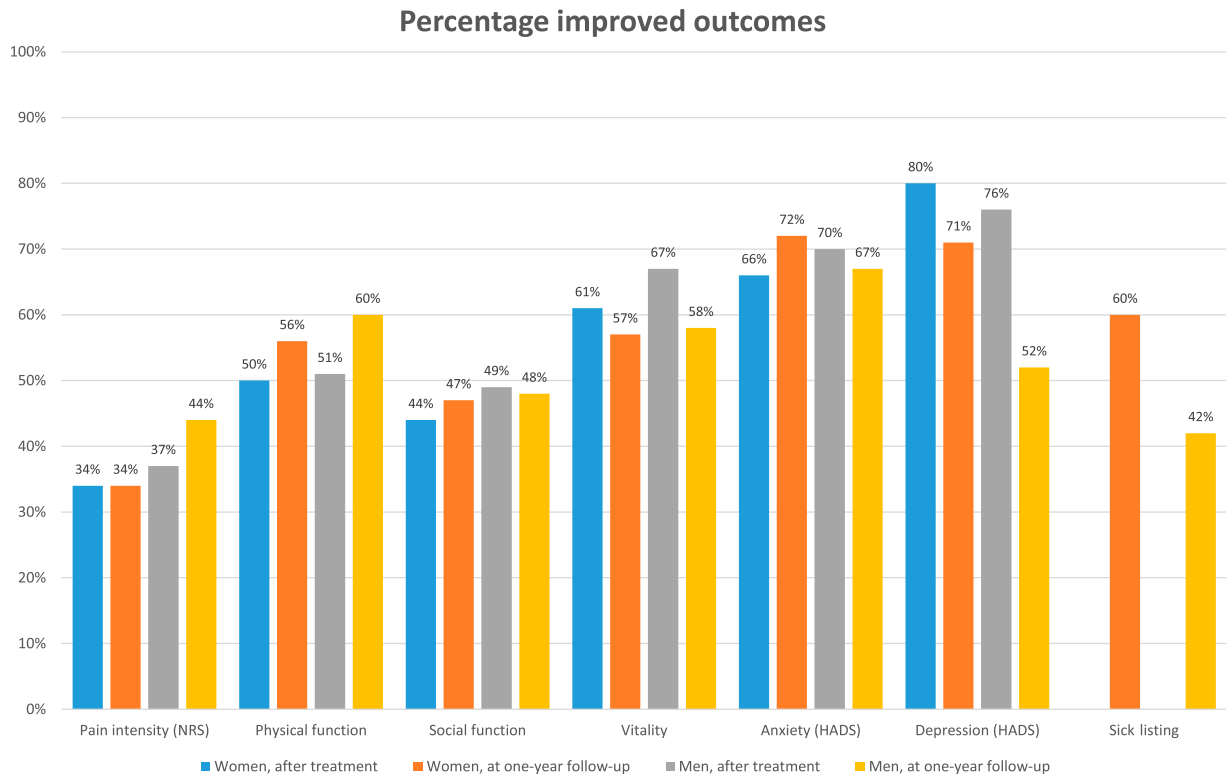

Figure 2. Percentage of improvement in the 6 outcome dimensions from baseline to end of treatment or to the 1-year follow-up, respectively, stratified for women and men.

intensity was the least likely outcome to improve, while depression was the most likely. About one-third of the patients improved in all or almost all outcomes, but another third improved in only 2 or fewer. These findings were similar also in the 1-year follow-up data.

Interestingly, the baseline factors associated with improvement after treatment were to a large extent pain characteristics, even if vitality and social function also played a role. Pain intensity was the predictor associated with many of the outcomes. With a few exceptions, we also saw that more severe health status at baseline was associated with a greater likelihood of improvement. In the 1-year data, pain intensity was still an important predictor.

Improvements in pain intensity and physical function seemed to represent lower global probability of improvement than most of the other outcomes (except social function). This finding might not be surprising because today's treatment schemes, at least in Sweden, mostly target improved quality of life, mental well-being, and activity, rather than pain intensity. Our finding of a low proportion of patients improving in pain intensity to some extent contradicts the conclusions of other studies.[3,9,13] This could at least partly be due to the different ways of handling outcomes and change evaluation. Most studies evaluate a continuous change. Some only look at statistically significant changes and ignore clinical relevance.[9] Some present measures of effect sizes, commonly Cohen's d.[3,13] We modeled change in pain intensity as a binary variable, defining an improvement as a decrease of at least the MID (2 steps on the scale). An improvement in pain intensity at the 1-year follow-up may provide evidence of effectiveness for multimodal pain programs in the long term. In our data, we saw a tendency of this for men but an unchanged improvement in pain intensity for women.

The associations of baseline factors with subsequent outcome were fewer than expected and weaker in predictive

Table 2

Principal component analysis of the change variables from baseline to end of treatment, respectively, 1-year follow-up.

Improved or not improved	To end of treatment, N = 262		To 1-year follow-up, N = 194	
	Principal component 1	Principal component 2	Principal component 1	Principal component 2
Pain intensity	0.739		0.716	
Physical function (SF-36)	0.793		0.705	
Social function (SF-36)	0.367	0.504	0.325	0.503
Vitality (SF-36)	0.468	0.324	0.667	
Anxiety (HADS)		0.736		0.872
Depression (HADS)		0.723		0.652

Factor loadings <0.3 are not presented, and the factors loaded on both dimensions were considered to load in the dimension with the highest load. Positive loadings mean improvement (eg, lower intensity and increased function).

HADS, Hospital Anxiety and Depression Scale.

Table 3

Distribution of the total improvement outcome, which is based on the number of positive changes (successful outcomes) from baseline to end of treatment.

Total improvement	Women		Men		All patients		
	%	n	%	n	%	95% CI	n
After treatment							
0–2	31%	59	31%	22	31%	25.3–36.4	81
3–4	42%	81	38%	27	41%	35.1–46.9	108
5–6	27%	51	31%	22	28%	22.5–33.2	73
At 1-year follow-up							
0–2	32%	47	29%	13	31%	24.8–37.8	60
3–4	40%	60	44%	20	41%	34.5–48.3	80
5–6	28%	42	27%	12	28%	22.0–34.5	54

CI, confidence interval.

ability, as also seen in an earlier study.[13] This could be due to small sample size, assessments with too much measurement errors, or failing to investigate the most important factors. For example, sleep problems, fear of movement, and pain acceptance can be important predictive factors, and they can also be important outcomes to improve in themselves.[5,10] However, these were not available in the registry at the time of the study. For many of the outcomes, a high probability of improvement was associated with characteristics representing negative status at baseline (eg, low vitality and high pain duration), although there were a few exceptions. This confirms some earlier findings[13] but might simply reflect that improvement from a low starting position is generally easier; almost the whole scale is available, and you are far from the ceiling effect. There were some exceptions; high pain intensity being an inhibitory factor for improvement in anxiety and depression, high depression is an inhibitory factor for improvement in vitality, and high social function is a facilitating factor for both improvement in social function and for global improvement.

Individual (as opposed to group-based) programs were associated with decreased pain intensity and possibly also with lower probability of improvement in social function. Except for these associations, we identified no differences in outcomes or even tendencies of differences between the 3 care units neither in the descriptive analysis nor in the regression analyses. This could partly be due to a small and heterogeneous patient group, but we interpret it to mean a lack of major differences across the care units after slightly different treatment approaches. Descriptively, we could see small differences in the baseline data between the care units. Compared with care units 1 and 2, care unit 3 seemed to have patients with higher educational level and a smaller proportion of patients with non-Nordic origin, widespread pain, or high degree of sick listing. However, these factors showed no clear association with the outcomes in the regression analyses.

6. Methodological issues

To achieve clinically relevant evaluations of multimodal pain programs, there is a need for standardized guidance regarding statistical methods and handling of multiple outcomes.[12,13] However, it is crucial to remember the balance between helpful advanced statistical methods and clinical interpretability of results. A marginal logistic regression has been suggested for handling multiple outcomes, at least if the outcomes are binary or can be dichotomized in a meaningful way.[4] This method is not new, but seldom is it used for solving this problem. The idea is interesting, but the marginal logistic model presents results for population effects and prevalence rather than individual effects. This is often not noted, and hence, results from marginal logistic models are often misinterpreted. We instead suggest the use of a random effects logistic model, as demonstrated in **Figure 3**. Unfortunately, our sample was too small to test the ability of a mixed effects logistic model to answer the main aim, but this would be an interesting idea for future studies.

Other suggestions for handling multiple correlated explanatory variables include the use of partial least squares and the SIMCA-P+ software package (Umetrics Inc., Umeå, Sweden) to simultaneously model several outcomes, thus using the total outcome information to analyze the association between

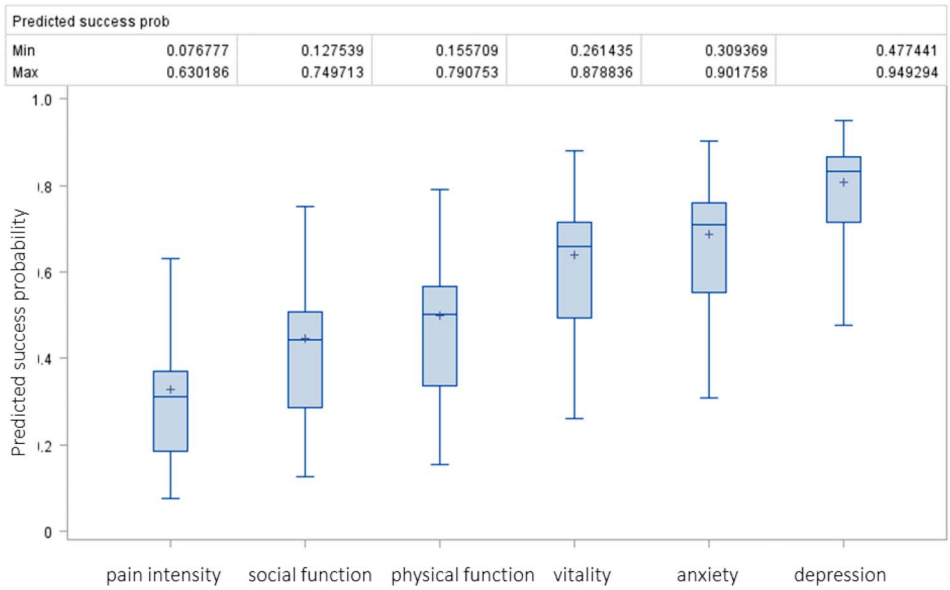

Figure 3. The outcomes ordered according to their probability of improvement. Estimates from the mixed effects logistic regression. The *y*-axis shows predicted value for probability to improve (predicted success probability).

Table 4

Improvement after treatment.

Variables	Improved outcome from baseline to end of treatment							
	Pain intensity	Physical function	Social function	Vitality	Anxiety	Depression	Total improvement (0–2, 3–4, or 5–6)	
	P-value	*P*-value	*P*-value	*P*-value	*P*-value	*P*-value	*P*-value	
	OR	*OR*	*OR*	*OR*	*OR*	*OR*	OR Odds (3–6) vs. Odds (0–2)	OR Odds (5–6) vs. Odds (0–2)
Gender	0.632	0.892	0.504	0.418	0.521	0.440	0.297	
Education Primary school (ref) Upper secondary school or university	0.880	0.945	0.181 1.06 0.61	0.987	0.745	0.783	0.710	
Origin	0.844	0.863	0.558	0.260	0.929	0.249 0.64	0.974	
Age	0.588	0.840	0.123 0.98	0.294	0.434	0.401	0.480	
Baseline values								
Pain sites (0–36)	0.889	0.249 1.02	0.581	0.114 1.03	0.364	0.182 1.03	0.348	
Constant pain (ref: periodic)	0.598	0.835	0.970	0.160 1.69	0.843	0.409	0.973	
Pain duration (mo)	0.070 1.002	0.652	0.898	0.176 1.002	0.862	0.257	0.348	
Pain intensity (NRS)	<0.001 1.42	0.295	0.466	0.452	0.079 0.87	0.016 0.80	0.567	
Physical function (SF-36)	0.014 0.98	<0.001 0.97	0.486	0.248 0.99	0.224 1.01	0.994	0.055 0.99	0.98
Social function (SF-36)	0.108 0.99	0.306	<0.001 0.96	0.009 0.99	0.818	0.599	0.019 0.99	0.98
Vitality (SF-36)	0.386	0.284	0.054 0.99	<0.001 0.96	0.521	0.831	0.008 0.98	0.98
Anxiety (HADS)	0.818	0.622	0.089 1.04	0.265	0.837	0.131 0.95	0.969	
Depression (HADS)	0.681	0.800	0.260	0.049 1.06	0.698	0.458	0.908	
Individual program (ref: group-based)	0.019 1.96	0.405	0.144 1.50	0.210 0.70	0.976	0.692	0.297	

Logistic regressions with 1 predictor at a time. Predictors with $P \leq 0.25$ are presented also with odds ratios.
HADS, Hospital Anxiety and Depression Scale; NRS, Numeric Rating Scale

explanatory variables and outcomes. Intuitively, this is similar to the efficiency of mixed effects models for analyzing repeated measures data by using the total information for all time points, instead of analyzing only pairs of time points as is often performed. On the other hand, partial least squares do not improve the possibility for clinically relevant interpretation of results. We have therefore suggested an initial naive way of combining analyses for separate outcomes and a summary outcome. Partial least squares as used by Gerdle et al. (2019) could be combined with our suggested approach for an analysis presenting results for separate outcomes. These would then be simultaneously modeled but presented as separate outcomes. Adding an analysis of the summary outcome also provides a way of investigating the suggested overall perspective.

Individual patients will vary in which outcomes and subgroups of outcomes are most important. We therefore emphasize the need to analyze effects of pain programs from both a single outcome perspective and an overall perspective. We chose to reduce the information to binary outcomes (improved or not) and then analyze a summary outcome based on the number of improved outcomes, where the small sample size forced us to combine the possible values into 3 categories. Dichotomizing variables always introduces the possibility of losing important information, but the potential advantages include increased interpretability and being forced to define what is clinically important. One general problem is the lack of consensus on how to define the outcomes, which partly explains why results differ between studies.

7. Strengths and limitations

One important strength of this study is the focus on both single outcomes, their interrelations, and the holistic overall outcome. This is one of the few studies comparing different multimodal pain programs, especially with focus on the individual- and the group-based approaches.

A limitation of this study is sample size, which, in the context of multiple outcomes with multidimensional causes in a highly heterogeneous patient group, must be considered small. As we had no control group in the study, it could be argued the improvement seen in outcomes might partly be due to natural course. However, the

Table 5

Improvement after treatment.

	Improved outcome from baseline to end of treatment							
Variables	**Pain intensity**	**Physical function**	**Social function**	**Vitality**	**Anxiety**	**Depression**	**Total improvement (0–2, 3–4, or 5–6)**	
Baseline values	***P*-value**	***P*-value**	***P*-value**	***P*-value**	***P*-value**	***P*-value**	***P***	
	OR	**OR**	**OR**	**OR**	**OR**	**OR**	**OR**	
	95% CI	**95% CI**	**95% CI**	**95% CI**	**95% CI**	**95% CI**	**95% CI**	
							Odds (3–6) vs. Odds (0–2)	**Odds (5–6) vs. Odds (0–2)**
Pain sites (0–36)						0.022 1.05 (1.01–1.09)		
Constant pain (ref: periodic)								
Pain duration (5 year increase)	0.047 1.01 (0.999–1.010)			0.229 1.09 (0.944–1.264)				
Pain intensity (NRS)	<0.001 1.4 (1.22–1.73)				0.075 0.87 (0.743–1.02)	0.002 0.74 (0.606–0.902)		
Physical function (SF-36)		<0.001 0.97 (0.960–0.984)						
Social function (SF-36)			<0.001 1.04 (1.03–1.06)				0.057 1.0 (0.988–1.02)	0.98 (0.970–1.00)
Vitality (SF-36)			0.164 0.99 (0.971–1.01)	<0.001 0.95 (0.930–0.966)			0.024 0.98 (0.958–0.994)	0.99 (0.971–1.01)
Anxiety (HADS)								
Depression (HADS)				0.073 0.94 (0.87–1.01)				
Individual only	0.008 2.3 (1.23–4.13)		0.203 0.67 (0.365–1.24)					
							0–2 vs 3–6*	5–6 vs 0–4*
Sensitivity	34%	58%	57%	90%	100%	100%	31%	18%
Specificity	91%	62%	35%	43%	†	†	85%	94%
LR+	3.8	1.5	0.88	1.6			2.1	3.0
LR−	0.73	0.68	1.2	0.23			0.81	0.87

Multivariable logistic regressions. The Likelihood ratio test for the parameters in the model. Variables were retained in the model if $P \leq 0.25$; these are the only variables presented in the table. Note that the demographic variables are not presented because none of them were included in the multiple models. The *P*-values are based on the likelihood ratio test and are type III *P*-values.

* The total improvement variable had 3 categories, and so, it is not possible to discuss sensitivity or specificity in the usual meaning.

† All individuals were predicted to improve.

CI, confidence interval; LR, likelihood ratio; HADS, Hospital Anxiety and Depression Scale; NRS, Numeric Rating Scale.

pain duration of these patients was long (with a mean of 99 months and a median of 57 months), and so, we consider it unlikely that natural course was the main reason for improvement.

8. Conclusions

Pain intensity is least while depression is most likely to be improved at the end of the treatment, using current multimodal pain treatment schemes. The treatment is clearly beneficial for some patients because about one-third improve over a wide range of outcomes. On the other hand, one-third of the patients improve in few or none of the outcomes.

Generally, patients with more severe health status at baseline improve to a larger extent directly after the treatment. The exceptions seem to be patients with high pain intensity and high depression at baseline, who are less likely to improve in mental aspects and vitality, respectively. However, these findings are not fully consistent over the 1-year follow-up.

Disclosures

The authors have no conflicts of interest to declare.

Supported by funding from AFA Insurance, Sweden (project grant AFA-160277). The funder had no involvement in performing the study. The support was only economical.

Acknowledgements

The authors thank all patients who patiently have filled in the questionnaires and approved of our use of these data to improve the quality of care and research. The authors also thank the staff at the different clinics for their work maintaining the registry and for their helpful answers to our questions about the structure and contents of the different pain programs.

Author contributions: A. Grimby-Ekman supervised the process, performed analyses, interpreted analyzed data, and was responsible for the main part of writing the manuscript. M. Kim analyzed the different pain programs. All authors participated in the study design,

retrieving the data, and discussing the manuscript. All authors have read and approved of the manuscript.

Appendix A. Supplemental digital content

Supplemental digital content associated with this article can be found online at http://links.lww.com/PR9/A110.

Article history:
Received 26 March 2021
Accepted 21 April 2021

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