Research Paper

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Expectations predict chronic pain treatment outcomes

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Abstract

Accumulating evidence suggests an association between patient pretreatment expectations and numerous health outcomes. However, it remains unclear if and how expectations relate to outcomes after treatments in multidisciplinary pain programs. The present study aims at investigating the predictive association between expectations and clinical outcomes in a large database of chronic pain patients. In this observational cohort study, participants were 2272 patients treated in one of 3 university-affiliated multidisciplinary pain treatment centers. All patients received personalized care, including medical, psychological, and/or physical interventions. Patient expectations regarding pain relief and improvements in quality of life and functioning were measured before the first visit to the pain centers and served as predictor variables. Changes in pain intensity, depressive symptoms, pain interference, and tendency to catastrophize, as well as satisfaction with pain treatment and global impressions of change at 6-month follow-up, were considered as treatment outcomes. Structural equation modeling analyses showed significant positive relationships between expectations and most clinical outcomes, and this association was largely mediated by patients' global impressions of change. Similar patterns of relationships between variables were also observed in various subgroups of patients based on sex, age, pain duration, and pain classification. Such results emphasize the relevance of patient expectations as a determinant of outcomes in multimodal pain treatment programs. Furthermore, the results suggest that superior clinical outcomes are observed in individuals who expect high positive outcomes as a result of treatment.

Keywords: Expectation, Impression of change, Chronic pain, Clinical outcomes, Multidisciplinary treatment

1. Introduction

Both medical and psychological factors can have an impact on patient recovery. A growing body of literature suggests that patients' pre-treatment expectations, or the estimated probability associated with a given outcome,[48] predict numerous health outcomes. Such expectations are considered important in placebo analgesia[19] and have been shown to have a significant impact on treatment response.[11,20,30] More precisely, expectations and their underlying neurobiological mechanisms have been linked to changes in pain intensity and other relevant clinical symptoms such as disability and emotional functioning,[20,48,57,64] independently of the treatment itself.[33,53,78] Generally, studies have shown that patients who forecast positive outcomes are more likely to improve than patients with less optimistic expectations.[6,22,56]

Several pathways may link patients' expectations to subsequent clinical outcomes.[22] For instance, it has previously been suggested that positive expectations influence subsequent outcomes by improving adherence to treatment[36] and reducing anxiety.[10,72] Expectations have also been linked to patients' subsequent impression of change in their health status after treatment.[2,39,70] Perceived treatment impact has, in return, been shown to reflect aspects of patients progress that are at least partly distinct from, but conceptually related to, changes in various more specific outcomes, such as pain intensity and level of daily functioning.[21,77] Additionally, a number of individual factors, such as sex,[28,62] age,[28,31] psychological distress,[47,62] and psychological traits[26,27,37] have been shown to modulate expectation. In an effort to improve our understanding of the relationship between expectations and outcomes, such factors must be considered.

Despite growing recognition of the relevance of expectations in clinical settings, evidence to support the predictive nature of expectations on chronic pain outcomes remains somewhat inconsistent. This may be explained by the use of small homogenous samples[24,65,80] and variations in the definition and measurement of expectations,[6,66,69] which makes it difficult to compare results between studies and generalize findings. More importantly, no study has explored the impact of expectations on outcomes following multidisciplinary pain programs which are generally designed to offer personalized combinations of interventions. Although often considered to be the treatment of choice, patients do not benefit equally from such programs.[23,35,75] Providing evidence for the predictive value of

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expectations in the context of multidisciplinary pain management might help explain part of this variability. Such findings could also provide more accurate prognosis and lead to the development of psychological interventions aimed at improving response to treatment.

The objective of the present study is to explore the association between pretreatment expectations and various clinical outcomes of patients having chronic pain entering a multidisciplinary pain program. Data were collected from a large-scale database of clinically representative patients in 3 tertiary multidisciplinary pain-management centers. We hypothesized that patients' pretreatment expectations would predict various health outcomes at 6-month follow-up and that patient's impressions of change mediate this association.

2. Methods

2.1. Participants

The sample was composed of a subset of patients enrolled in the Quebec Pain Registry (QPR; for more information: http://www.quebecpainregistry.org). Participants were patients having chronic pain included in the QPR between November 1, 2008 and April 31, 2012 and treated in one of 3 tertiary care multidisciplinary pain-treatment centers affiliated with the University of Montreal, McGill University, and the University of Sherbrooke (Quebec, Canada). Patients were referred to the pain centers by their attending physician, and participants in this study presented with pain extending beyond the expected period of healing. Most participants (95%) had pain for at least 3 months. To be eligible for the present study, participants had to provide written consent for the use of their QPR data for research purposes and complete QPR measures before their initial visit at the pain center (baseline data including items pertaining to pretreatment expectations) and 6 months later (follow-up measures).

As presented in **Figure 1**, of the 4178 patients enrolled in the QPR between November 2008 and April 2012, 1068 did not meet the inclusion criteria for the present study and 838 were excluded from the statistical analyses because of missing data. Therefore, the final sample comprised the data of 2272 patients.

2.2. Procedure

2.2.1. Ethics

The Research Ethics Board of the Centre de recherche de l'Institut universitaire de gériatrie de Montreal approved the present study. All participants had previously signed an informed consent form approved by the institutional ethics board of the respective pain centers participating in the QPR, and authorized the use of their data for research purposes.

2.2.2. Data collection

Baseline (0M) and 6-month (6M) follow-up data were collected from every new patient in each pain center and entered into the QPR. Patients were mailed a letter signed by the Medical Director of the pain center, informing them that the data collection was designed to follow up the clinical progress in their condition over time and would be used anonymously for administrative statistics. Patients were also invited to sign a consent form authorizing researchers to conduct studies on data contained in the QPR. Choice of outcome measures included in the QPR was based on published recommendations for clinical trials on chronic pain.[15]

At 0M, data were collected via a self-administered questionnaire to be returned by mail. The questionnaire included standardized validated scales designed to gather information on the patient's pain characteristics, impact of pain on daily living, psychological distress and coping, pretreatment expectations, and sociodemographic variables. Upon reception of the completed questionnaire, the QPR nurse contacted each patient to validate the responses to the questionnaires and collect additional information. Structured telephone or face-to-face interviews were used to collect information such as cause and duration of pain, as well as current and past pharmacological and nonpharmacological treatments for pain.

At 6M, pain intensity and impact of pain on daily living, psychological distress, and coping were reassessed using the same scales/questionnaires used at 0M. Patients' impression of change was also measured, along with satisfaction with treatment received at the pain center. In addition, the QPR nurse interviewed each patient and reviewed his/her medical chart to collect data pertaining to current treatments and to treatments received in the past 6M. Information was also gathered concerning the number of health professionals consulted at the pain center, in the hospital, and/or outside the hospital. Primary pain diagnosis established by the treating physician at the pain center was also recorded.

2.3. Measures

2.3.1. Expectations

Before their initial visit, patients were invited to rate specific outcomes expected in the following 6M as a result of treatment, namely pain relief, level of functioning, and quality of life. A 0 to 100 scale ranging from "no relief" to "complete relief" was provided, and patients were asked to indicate their expected percentage of pain relief over the coming 6M.[38,43] Expected changes in functioning and quality of life were reported via a modified version of the Patient Global Impression of Change scale; the scale ranged from 0 to 6, with "no change" as the midpoint, and "considerably deteriorate" and "considerably improve" as anchors.[15,17]

2.3.2. Pain intensity

Pain intensity was assessed using an 11-point numerical rating scale ranging from 0 to 10, with "no pain" and "worst pain possible" as anchors.[44] Participants were instructed to rate their average pain during the past week. Change in pain intensity was indexed by the difference between the 0M and 6M measures (ie, positive values reflect reduced pain).

2.3.3. Depressive symptoms

Depression levels were assessed with the Beck Depression Inventory-I; this scale provides a total score ranging from 0 to 63, with higher scores indicating more severe depressive symptoms.[3] Change in the level of depression was indexed by the difference between the 0M and 6M measures (ie, positive values reflect reduced depressive symptoms).

2.3.4. Pain interference

Pain impact on daily functioning was measured using the interference items in the modified Brief Pain Inventory.[9,76] The mean of the scores provided on the 10 interference items (general activity, mood, mobility, normal work, relationships with others,

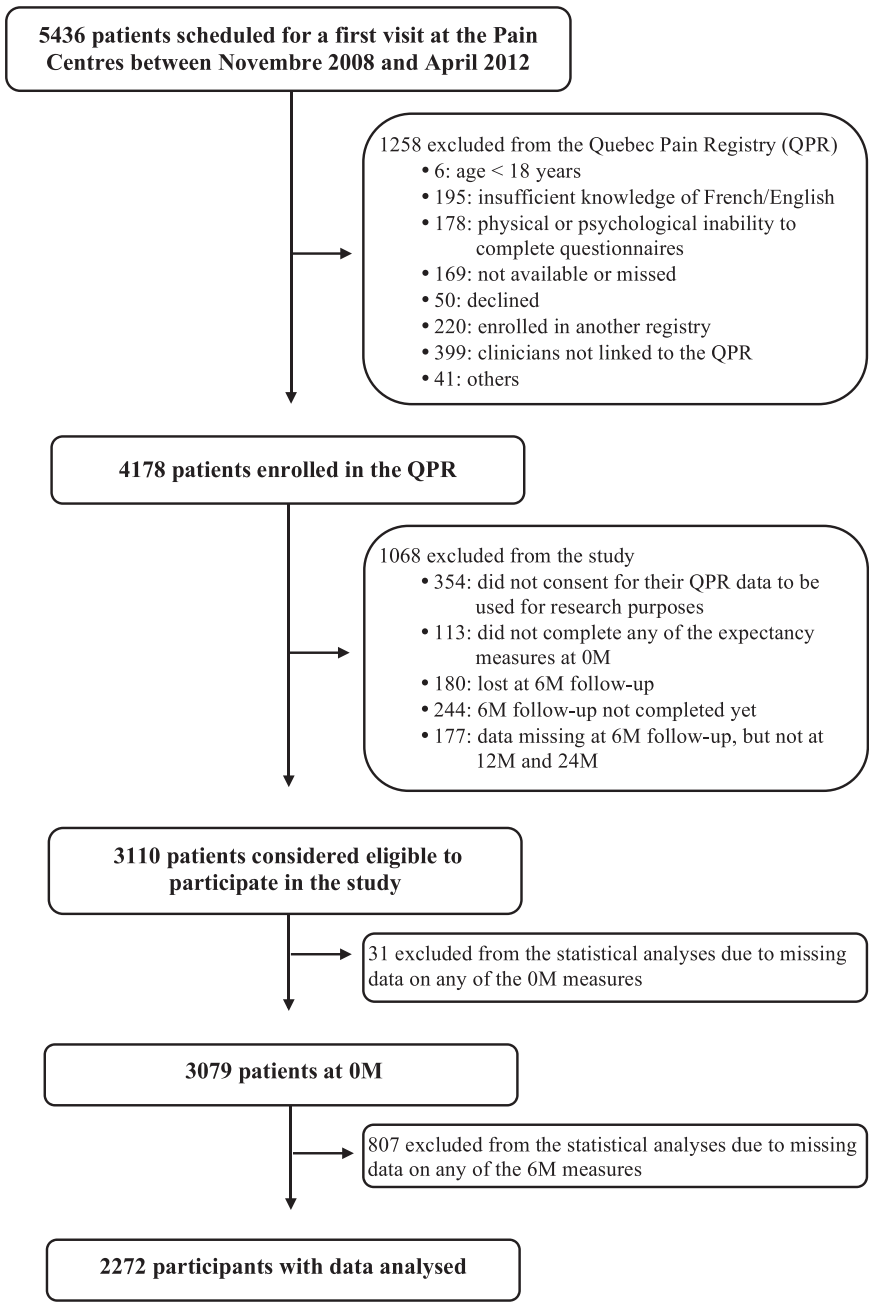

Figure 1. Flow chart of participants.

sleep, enjoyment of life, self-care, recreational activities, and social activities) ranged between 0 and 10, with higher scores reflecting greater impairment and greater interference of pain in daily functioning. The change in pain interference was indexed by the difference between the 0M and 6M measures (ie, positive values reflect reduced pain interference).

2.3.5. Pain catastrophizing

Multidisciplinary pain treatment programs often aim to improve coping by reducing the tendency to catastrophize in the face of pain.[45] Catastrophizing was assessed via the Pain Catastrophizing Scale[73]; this scale provides a total score ranging from 13 to 65, with a higher score indicating a stronger tendency to catastrophize. Change in pain catastrophizing was indexed by the difference between the 0M and 6M measures (ie, positive values reflect reduced pain catastrophizing).

2.3.6. Treatment satisfaction

Patients' satisfaction with treatments received at the pain clinic in the past 6M was measured with a 6-point scale ranging from 0 to 5, with "very dissatisfied" and "very satisfied" as anchors.

2.3.7. Global impression of change

At 6M, patients were asked to rate perceived change since their initial visit, using a scale similar to the Patient Global Impression of Change scale. Perceived improvement in the level of functioning and quality of life was rated on a 7-point scale ranging from 0 to 6,

with "considerably deteriorate" and "considerably improve" as anchors and "no change" as the midpoint. Patients were also invited to provide a percentage for perceived change in pain relief on a 0 to 100 scale ranging from "no relief" to "complete relief". In order to have patients' perception of their own treatment response and overall degree of improvement, the mean of all 3 standardized items was calculated to provide a global impression of change score.

2.4. Data analyses

Results are expressed as mean ± SD or percentage. Structural equation modeling (SEM) analyses were conducted with Lisrel 8.80. Structural equation modeling is a statistical technique designed to test complex statistical models of the relationships between one or more independent and dependent variables. Among other things, SEM tests mediation, which refers to the causal process between 3 or more variables. Analyses were performed with the covariance matrix using the maximum likelihood estimation procedure. The following goodness-of-fit indices were used to determine adequate fit of the models[46,54]: the χ^2 goodness-of-fit statistic; the Root Mean Square Error of Approximation (RMSEA) and its 90% confidence interval; the Normed Fit Index (NFI); the Non-NFI (NNFI); the comparative Fit Index (CFI); the Goodness of Fit Index (GFI), and the Standardized Root Mean Square Residuals (SRMR). To be deemed satisfactory, the χ^2 statistic should not be significant, the NFI, NNFI, CFI and GFI values should be greater than 0.90,[41] the RMSEA values should be less than 0.08 with a 90% confidence interval upper limit under 0.10[12] and the SRMR value should be less than 0.05. The significance of the mediation effects was assessed using the Sobel test.

To determine whether the selected structural model is valid for various subgroups, subsequent multigroup structural analyses were conducted. The adequate 4-step procedure for conducting multigroup structural analysis is to (1) test the final model with the entire sample, (2) test the final model with each group separately, (3) test the multigroup model specifying that the same patterns of relationships must be found in all subgroups, and (4) compute the χ^2 difference between the multigroup structural model's χ^2 and the χ^2 of the final model with the entire sample. To demonstrate that the same patterns can be found in all subgroups, the χ^2 difference must not be significant.[13]

3. Results

3.1. Baseline characteristics

Flow chart of participants is presented in **Figure 1**. The patients in the final sample comprised 2272 participants, between 18 and 94 years old, with a mean age of 53.7 ± 14.2 years. Females comprised 59.9% of the sample, and the vast majority of participants were white (94%). Other relevant sociodemographic characteristics of the participants are presented in **Table 1**. Patients who only completed the measures at 0M were significantly younger (50.9 ± 14.6) than those who completed measurements at both time points (53.7 ± 14.2; $F(1, 3111) = 24$, $P = 0.0001$). No other significant differences were found.

Pain was the result of a traumatic incident in 37.1% of participants, and lumbar pain was the most common primary diagnosis made by the treating physician at the pain center (**Table 2**). Duration of pain varied from 0.1 to 64 years, with a mean of 6.3 ± 8.3 years. Average pain in the past week was ≥7/10 in 60.4% of patients, and one in 3 patients reported that their pain severely impacted (≥7/10) various aspects of daily living. Results on the BDI revealed moderate to extremely severe depression in 44.4% of patients. One in 5 patients presented significant levels of pain catastrophizing (Pain Catastrophizing Scale score ≥40).

Table 1

Sociodemographic characteristics of patients at baseline.

Characteristics	% (n)
Age, y	53.7 ± 14.2
<40	15.5 (352)
40-60	54.9 (1248)
>60	29.6 (672)
Sex (female)	59.9 (1361)
Ethnicity (white)	94 (2136)
Civil status	
Single	22.8 (519)
Married or common-law	55.5 (1260)
Separated, divorced or widowed	21.7 (493)
Education level	
None, elementary, or high school	49.2 (1117)
College–technical school	25.9 (588)
University	25 (567)
Employment status	
Employed (including students, homemakers, maternity leave)	35.9 (816)
Retired	22.8 (518)
Unable to work (because of illness or disability)	34.7 (789)
Unemployed	6.6 (149)
Annual family income	
<$20,000	25.2 (572)
$20,000-$49,999	32.8 (745)
>$50,000	30.5 (692)
Do not wish to answer	11.6 (263)
Disability benefits	
Currently receiving	28.5 (648)
In process	10.2 (231)
Pain-related litigation	8.8 (132)

3.2. Patient expectations regarding pain treatment

When questioned about the changes expected to occur by 6M after their initial visit at the pain centre, almost one-quarter of the sample (23.7%) expected pain relief equal or superior to 90%. In fact, 13.7% of these patients expected to be cured of their pain condition (100% relief) after 6M of treatment. Almost two-thirds of patients (60%) expected pain relief ranging from 40% to 80%, while 16.3% expected a pain relief of 30% or less. Among them, a minority (2.4%) expected no pain relief after treatments (see mean and SD in **Table 3**). Great or considerable improvements (score ≥5/6) in functioning and quality of life were expected by 43.2% and 44.9% of patients, respectively. A minority of patients expected their level of functioning (8.5%) and quality of life (6.3%) to remain the same or to deteriorate.

3.3. Pain treatments received

At 6M follow-up, patients had attended an average of 5.0 ± 5.3 appointments at the pain center or hospital (median = 4 appointments). Pain treatments received during this period encompassed medical (eg, nerve block or other anesthetic techniques), psychological (including individual and group psychotherapy), physical (including physiotherapy), and/or other types of interventions. A total of 61.1% of patients received a combination of at least 2 different treatment modalities. Beyond

Table 2

Pain and psychological characteristics of patients at baseline.

Characteristics	% (n)
Cause of pain	
Trauma	37.1 (834)
Surgery	9.8 (220)
Illness (including cancer)	22.5 (505)
No precise event	23.6 (530)
Other	7.1 (160)
Pain classification (location; only >10% reported)	
Lumbar pain	32.5 (738)
Lower limb pain	12.7 (289)
Generalized syndrome	12 (272)
Upper limb pain	11.8 (267)
Cervical pain	9.7 (221)
Pain duration, y	6.3 ± 8.3
<2	31.3 (706)
2-5	35.8 (807)
6-10	15.8 (356)
>10	17 (383)
Average pain intensity in the past 7 d (NRS)	6.8 ± 2
Mild (0-3)	6.9 (157)
Moderate (4-6)	32.7 (743)
Severe (7–10)	60.3 (1372)
Pain interference (global mean BPI score)	5.7 ± 2.2
Mild (0-3)	21.3 (484)
Moderate (4-6)	54.1 (1230)
Severe (7-10)	32.8 (746)
Depression levels (BDI)	18.6 ± 10.4
Normal (0-9)	19.6 (446)
Mild to moderate (10-18)	36 (818)
Moderate to severe (19-29)	29 (659)
Severe to extremely severe (30-63)	15.4 (349)
Pain catastrophizing (PCS)	29.6 ± 12.7
Severe (>40)	25.3 (574)

BDI, Beck Depression Inventory-I; BPI, Brief Pain Inventory; NRS, numerical rating scale; PCS, Pain Catastrophizing Scale.

the 6M point, one or more follow-up visits were planned for 78.4% of patients, whereas the remainder were discharged from the clinic (18.2%) or decided not to return (3.3%).

3.4. Predictors of outcome measures and mediating variables

The models tested in the present study were composed of 9 variables (see Pearson correlations in **Table 3**). Expected relief and expected improvement in quality of life and in functioning were all modeled at 0M as predictors (exogenous variables). Changes in pain intensity, depressive symptoms, pain interference, and pain catastrophizing between 0M and 6M, as well as global impression of change and satisfaction with treatments at 6M, were modeled as outcomes (endogenous variables).

The initial model tested was based on the hypothesis that global impressions of change would mediate the relationships between the 3 expectation variables and all outcome variables. This model had a good fit to the data (RMSEA = 0.002 [0.01; 0.03], NFI = 1.00, NNFI = 1.00, CFI = 1.00, GFI = 1.00, and SRMR = 0.02), but the χ^2 statistic was found to be significant (χ^2 (df = 15, N = 2272) = 28.6, $P = 0.02$), indicating the lack of a satisfactory model fit. Inspection of the residual matrix suggested direct relationships between expected pain relief at the initial visit and changes in reported pain intensity and depressive symptoms. As a result, a second model that included these 2 direct relationships was tested. The second model had a better fit to the data and was therefore preferred over the initial model (χ^2 (df = 13, N = 2272) = 5.84, $P = 0.95$, RMSEA = 0.00 [0.00; 0.00], NFI = 1.00, NNFI = 1.00, CFI = 1.00, GFI = 1.00 and SRMR = 0.001). This final model was also shown to be superior to an alternative model in which changes in pain intensity were a mediator between expectations and all outcomes (**Table 4**).

As illustrated in **Figure 2**, the composite measure of global impression of change was significantly and positively related to prior expectations (0M) of pain relief and of improvement in quality of life, but not improvement in functioning. Furthermore, all outcome measures were strongly and positively related to global impression of change. The significance of the mediating effects of global impression of change was further confirmed by Sobel tests (**Table 5**). The proportion of variance explained by the proposed model, that is, the combination of the predictors and global impression of change, was 23% for changes in pain intensity, 10% for changes in depressive symptoms, 24% for changes in pain interference, 15% for changes in pain catastrophizing and 14% for satisfaction with treatments. Finally, independently from global impression of change, the positive and significant relationship was observed between expected relief at 0M and changes in pain intensity, whereas a negative and significant relationship was found between expected relief at 0M and changes in depressive symptoms.

Univariate analyses of variance were conducted to further confirm that higher expectations systematically lead to superior health outcomes. Three categories of expectations' strength were created based on data distribution and clinical relevancy. In comparison to those with low (0%-30%) or moderate (40%-80%) pain relief expectations, patients expecting high pain relief (90%-100%) reported significantly better outcomes at 6M (all P's ≤

Table 3

Correlation matrix, mean, and SD of predictors and outcomes.

Variables*	Mean ± SD	1	2	3	4	5	6	7	8	9
1—Expected relief 0M (0-100)	64.44 ± 26.29	1.00								
2—Expected improvement in quality of life 0M	4.76 ± 0.91	0.62†	1.00							
3—Expected improvement in functioning 0M	4.69 ± 0.99	0.58†	0.73†	1.00						
4—Changes in pain intensity (NRS)	0.85 ± 2.25	0.18†	0.14†	0.12†	1.00					
5—Changes in depressive symptoms (BDI)	1.46 ± 7.61	0.02	0.04‡	0.04	0.24†	1.00				
6—Changes in pain interference (BPI)	0.76 ± 2.10	0.12†	0.12†	0.10†	0.59†	0.38†	1.00			
7—Changes in pain catastrophizing (PCS)	4.19 ± 11.03	0.11†	0.09†	0.08†	0.38†	0.42†	0.44†	1.00		
8—Global impression of change	0.01 ± 0.88	0.23†	0.19†	0.17†	0.47†	0.31†	0.49†	0.39†	1.00	
9—Satisfaction with treatment	4.21 ± 1.83	0.09†	0.09†	0.08†	0.17†	0.11†	0.19†	0.20†	0.37†	1.00

* Positive values for variables 4 to 7 reflect improvements.
† $P < 0.001$.
‡ $P < 0.05$.
BDI, Beck Depression Inventory-I; BPI, Brief Pain Inventory; PCS, Pain Catastrophizing Scale.

Table 4

Models tested and validity of the final model for subgroups.

Model*	χ^2 (df, N)	RMSEA (90% CI)	NFI	NNFI	CFI	GFI	SRMR	M_{final} vs. $M_{same\ pattern}$ $\Delta\chi^2$ (Δdf)†
Models tested across all patients								
Initial model	χ^2 (df = 15, N = 2272) = 28.64, $P = 0.02$	0.02 [0.01; 0.03]	1.00	1.00	1.00	1.00	0.02	
Final model	χ^2 (df = 13, N = 2272) = 5.84, $P = 0.95$	0.00 [0.00; 0.00]	1.00	1.00	1.00	1.00	0.001	
Alternative model	χ^2 (df = 14, N = 2272) = 26.1, $P = 0.03$	0.02 [0.01; 0.03]	1.00	1.00	1.00	1.00	0.02	
Models tested across subgroups of patients								
Sex								
Females (A)	χ^2 (df = 13, N = 1361) = 2.98, $P = 1.00$	0.00 [0.00; 0.00]	1.00	1.00	1.00	1.00	0.001	
Males (B)	χ^2 (df = 13, N = 911) = 11.65, $P = 0.56$	0.00 [0.00; 0.03]	1.00	1.00	1.00	1.00	0.02	
Same pattern	χ^2 (df = 26, N = 2272) = 14.63, $P = 0.56$	0.00 [0.00; 0.00]	1.00	1.00	1.00	A: 1.00	A: 0.02	8.79 (13), $P > 0.05$
	A: % of χ^2 = 79.65%					B: 1.00	B: 0.001	
	B: % of χ^2 = 20.35%							
Age, y								
<53 (C)	χ^2 (df = 13, N = 1099) = 9.04, $P = 0.77$	0.00 [0.00; 0.02]	1.00	1.00	1.00	1.00	0.01	
>53 (D)	χ^2 (df = 13, N = 1173) = 14.46, $P = 0.34$	0.01 [0.00; 0.03]	1.00	1.00	1.00	1.00	0.02	
Same pattern	χ^2 (df = 26, N = 2272) = 23.51, $P = 0.60$	0.00 [0.00; 0.02]	1.00	1.00	1.00	C: 1.00	C: 0.01	17.67 (13), $P > 0.05$
	C: % of χ^2 = 38.45%					D: 1.00	D: 0.02	
	D: % of χ^2 = 61.55%							
Pain duration, y								
<5 (E)	χ^2 (df = 13, N = 1513) = 6.04, $P = 0.94$	0.00 [0.00; 0.03]	1.00	1.00	1.00	1.00	0.01	
>6 (F)	χ^2 (df = 13, N = 739) = 16.49, $P = 0.22$	0.02 [0.00; 0.04]	0.99	1.00	0.99	1.00	0.02	
Same pattern	χ^2 (df = 26, N = 2272) = 22.53, $P = 0.66$	0.00 [0.00; 0.02]	1.00	1.00	1.00	E: 1.00	E: 0.001	16.69 (13), $P > 0.05$
	E: % of χ^2 = 26.70%					F: 1.00	F: 0.024	
	F: % of χ^2 = 73.30%							
Primary diagnostic								
Lumbar pain (G)	χ^2 (df = 13, N = 738) = 17.28, $P = 0.19$	0.02 [0.00; 0.05]	0.99	0.99	1.00	0.99	0.02	
Generalized (H)	χ^2 (df = 13, N = 272) = 14.17, $P = 0.36$	0.02 [0.00; 0.07]	0.98	1.00	1.00	0.99	0.03	
Limb pain (I)	χ^2 (df = 13, N = 556) = 6.85, $P = 0.91$	0.00 [0.00; 0.02]	1.00	1.00	1.00	0.99	0.01	
Same pattern	χ^2 (df = 39, N = 1566) = 38.29, $P = 0.50$	0.00 [0.00; 0.03]	0.99	1.00	1.00	G: 0.99	G: 0.02	32.45 (26), $P > 0.05$
	G: % of χ^2 = 17.17%					H: 0.99	H: 0.03	
	H: % of χ^2 = 30.58%					I: 1.00	I: 0.01	
	I: % of χ^2 = 33.00%							

* To be deemed satisfactory, the χ^2 statistic should not be significant; the NFI, NNFI, CFI, and GFI should have values greater than 0.90[43]; the RMSEA should have a value smaller than 0.08; and the upper limit of its 90% confidence interval should be smaller than 0.10[44]; and finally, the SRMR should have a value smaller than 0.05.

† The 4-step procedure for conducting multigroup structural analysis is to (1) test the final model with the entire sample, (2) test the final model with each group separately, (3) test the multigroup model specifying that the same patterns of relationships must be found in all subgroups, and (4) compute the χ^2 difference between the multigroup structural model's χ^2 and the χ^2 of the final model with the entire sample. To demonstrate that the same patterns can be found in all subgroups, the χ^2 difference must not be found to be significant.[45]

CFI, comparative Fit Index; GFI, Goodness of Fit Index; NFI, Normed Fit Index; NNFI, the Non-NFI; RMSEA, Root Mean Square Error of Approximation; SRMR, Standardized Root Mean Square Residuals.

Table 5

The mediating effects of global impression of change.

	Sobel tests Z values
Expected relief 0M → global impression of change 6M → changes in pain intensity (NRS)	14.27*
Expected relief 0M → global impression of change 6M → changes in depressive symptoms (BDI)	11.82*
Expected relief 0M → global impression of change 6M → changes in pain interference (BPI)	15.29*
Expected relief 0M → global impression of change 6M → changes in pain catastrophizing (PCS)	13.54*
Expected relief 0M → global impression of change 6M → satisfaction with treatment 6M	13.15*
Expected quality of life 0M → global impression of change 6M → changes in pain intensity (NRS)	1.99†
Expected quality of life 0M → global impression of change 6M → changes in depressive symptoms (BDI)	1.98†
Expected quality of life 0M → global impression of change 6M → changes in pain interference (BPI)	2.00†
Expected quality of life 0M → global impression of change 6M → changes in pain catastrophizing (PCS)	1.99†
Expected quality of life 0M → global impression of change 6M → satisfaction with treatment 6M	1.99†
Expected functioning 0M → global impression of change 6M → changes in pain intensity (NRS)	0.33 ns
Expected functioning 0M → global impression of change 6M → changes in depressive symptoms (BDI)	0.33 ns
Expected functioning 0M → global impression of change 6M → changes in pain interference (BPI)	0.33 ns
Expected functioning 0M → global impression of change 6M → changes in pain catastrophizing (PCS)	0.33 ns
Expected functioning 0M → global impression of change 6M → satisfaction with treatment 6M	0.33 ns

* $P < 0.001$.
† $P < 0.05$.
BDI, Beck Depression Inventory-I; BPI, Brief Pain Inventory; ns, not significant; PCS, Pain Catastrophizing Scale.

0.005), except for changes in depressive symptoms ($P \geq 0.89$), which did not vary according to the strength of pain relief expectations. Likewise, when compared with those who had low (scores between 0 and 3) to moderate (scores of 4 or 5) expectations, patients expecting treatments would lead to considerable improvements (score of 6) in their quality of life also reported better overall outcomes at 6M (all P's ≤ 0.001), aside from changes in depressive symptoms ($P \geq 0.18$).

Finally, multigroup structural analyses were conducted to determine whether or not the structural model is valid for various subgroups. Multigroup models were tested by gender (females, males), age (younger than 53 years, 53 years and older), pain duration (0-5 years, more than 5 years), and pain classification (lumbar pain, generalized syndrome, and upper and lower limb pain). **Table 4** presents the results of these analyses and indicates that the proposed model presented a good fit to the data in each subgroup. Furthermore, the χ^2 statistic differences between the final model conducted on the entire sample and the multigroup analysis were nonsignificant. Thus, results indicate that the patterns of relationships in the final model (**Figure 2**) are also observed in all subgroups. Although this finding does not imply that the factor structure is equivalent across all groups, it confirms similarity in regard to the factors and the parameters depicted in the model.

4. Discussion

The present study examined the contribution of pretreatment expectations to subsequent outcomes in a large data set of patients having chronic pain treated in multidisciplinary pain centers. The results reveal that the expectations of patients having chronic pain predict clinical outcomes and that the observed relationship is largely mediated by the patients' global impression of change. Although expected improvement in functioning proved to be unrelated to outcomes, both expected pain relief and expected improvement in quality of life were significant predictors of all outcomes. Overall, the results demonstrate that response to pain treatment reflects the patients' pretreatment expectations and their impression of change after receiving care and suggest that high positive expectations are linked to superior treatment gains.

Global impression of change was a better mediator of the association between expectations and outcomes than changes in pain intensity. This may be surprising considering the primary focus of *pain* clinics, but this result may reflect the fact that multidisciplinary treatments are designed not only to relieve pain but also to improve functioning, emotional state, and overall quality of life. It would therefore be misleading to conceive decreased pain as the sole indicator of treatment success. However, global impression of change was shown to mediate only partially the association between expectations and changes in pain and depressive symptoms. This finding is consistent with the literature[58,59,71] and with Kirsch's response expectancy theory, which suggests that expectations of subjective responses such as pain and depression may be sufficient to cause at least part of the changes in these outcomes.[48] Nonetheless, here, expected relief measured at 0M was weakly but negatively associated with changes in depressive symptoms at follow-up. Further research is required to elucidate this association, part of which may be explained by the desire for relief, a factor thought to underlie, along with expectations, common human emotions.[63,79]

Given that the value and extent of therapeutic changes are fundamentally subjective, it is essential to assess individual experience with treatment and to understand what is considered a meaningful improvement to them. Impression of change encompasses a patient's interpretation and judgment, which is colored by their own experience. Global ratings help capture a patient's level of overall well-being at a specific point in time, and, unlike measures used to assess specific symptoms, they incorporate broader aspects of the pain condition, such as consequent losses and impact on quality of life. A favorable overall impression of treatment has previously been linked to various outcomes including pain relief, reduced disability, improved coping strategies, and improved mood.[7,8,55] Nevertheless, it remains unclear which information patients use to establish their overall impression. The impact of memory on ratings,[18,25] as well as the extent to which patients are able to accurately recall their condition at admission and contrast it with their current state,[34] remains to be established.

Perception is often largely determined by what individuals expect. Expectations may therefore prepare patients to focus on specific aspects and symptoms of their condition while ignoring others[22] and influence how they interpret their condition.[74] A study on the role of expectations in patients' reports of postoperative outcomes illustrated this phenomenon by demonstrating that expectations did not directly alter outcomes such as pain and fatigue but instead caused individuals to adopt a more positive outlook on their condition.[22] In the present study, individuals expecting more positive changes after treatment may have been more inclined to detect signs of improvements, in turn leading to amelioration in all outcomes. However, it remains unclear whether or not expectations reflect a general belief in good outcomes in the face of difficulties or a more cognitive

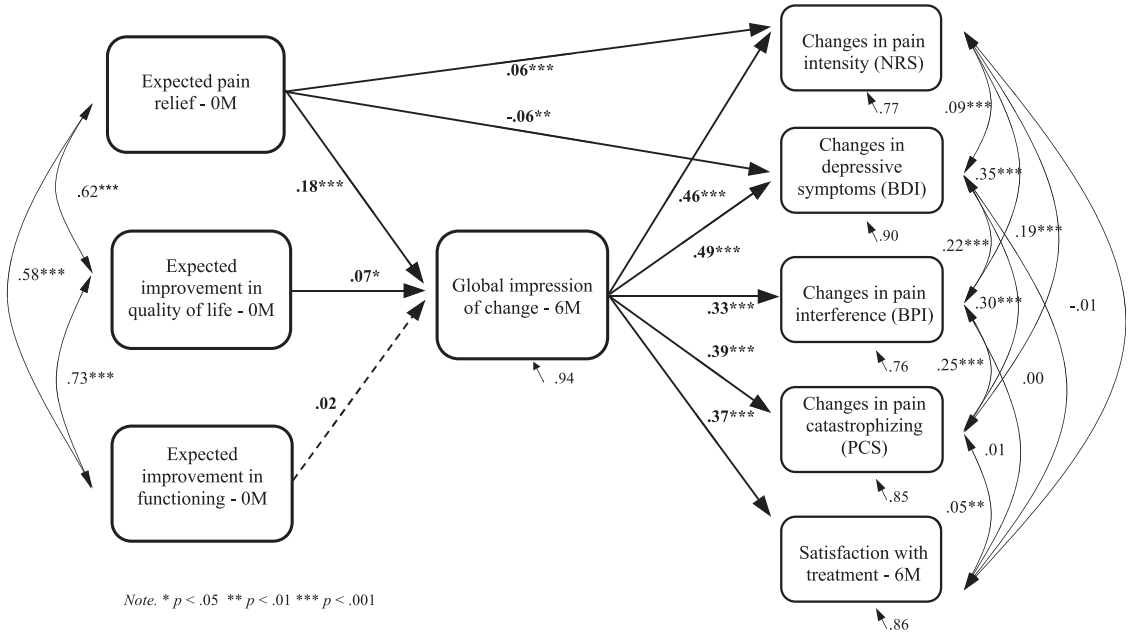

Figure 2. The relationship between expectations and outcomes mediated by global impression of change: final model.

approach in which probabilities are considered and optimism is based on valid information about treatment.[67]

In the clinical context, other cognitive and behavioral factors have also been shown to mediate, at least partly, the association between expectations and outcomes. Adherence to self-management strategies has been shown to predict greater improvement in pain, disability, and depression severity.[60] In fact, a recent study has shown that the relationship between expectations and outcomes is partly mediated by adherence to treatment.[36] Therefore, patients with higher expectations may be more motivated to comply with a treatment regimen shown to be associated with greater improvements.[68] Although adherence to treatment helps explain part of this association, other pathways are likely involved. For instance, expectations may also affect outcomes by triggering a physiological response[4,16,52] and by acting on anxiety to heighten or reduce symptoms.[10,72] It is therefore reasonable to think that several mechanisms operate simultaneously to explain the association between expectations and outcomes, and further investigation is necessary to confirm this possibility.

In the present study, a surprising number of patients anticipated considerable improvements and relief greater than 90%. Commonly viewed as excessive, not to say unrealistic, such high levels of expectations are commonly thought to be detrimental to patients. Nonetheless, our study demonstrates that these expectations were linked to superior clinical outcomes in all domains, with the exception of depressive symptoms. In fact, these findings contradict those of previous studies suggesting that moderate, as opposed to excessively high or low expectations, are associated with better outcomes.[29,49,61] It is plausible that highly positive expectations at least partly reflect dispositional optimism, or the general tendency to anticipate good outcomes in the face of difficulties, which has consistently been linked to better health outcomes.[26,27,37]

Expectations result from direct and indirect experiences. They are the product of personal experiences with behaviors and their consequences and can be acquired by observing others or through suggestions.[1] Expectations are therefore unique to the individual who holds them. Consequently, in addition to dispositional optimism, other individual factors have been shown to modulate pretreatment expectations. Previous studies have shown that sex,[28,62] age,[28,31] education level,[28,62] and psychological distress[47,62] influence the magnitude of pretreatment expectations which should, subsequently, influence treatment outcomes. For instance, some studies have reported that males with less education and more depressive symptoms have more pessimistic expectations,[62] whereas more positive expectations are reported by patients reporting less fear and receiving less disability compensation.[32]

The model proposed in the present study was shown to be relevant across subgroups of patients based on biological and clinical criteria. This finding reiterates the importance of the association between expectations and outcomes, beyond other dimensions of interest. In fact, it empirically validates the proposition that positive expectations predict better health outcomes independently of the pain condition, the precise treatment received and the clinical outcomes measured.[56] Nevertheless, such results do not imply that the proposed model holds up under all circumstances. Future studies need to explore individual factors that might moderate the association between expectations and outcomes.

Traditionally viewed as artifacts to be controlled, expectations are now regarded as a promising catalyst for change and should be considered important in improving treatment success. Learning to elicit, assess, and incorporate patients' expectations regarding their overall condition into available treatments may optimize treatment response.[51] There is growing evidence that clinician–patient interactions can enhance or attenuate patient expectations.[14] Communicating expectations of treatment success can contribute to decreased pain and improved functioning in patients.[5,19,42] The quality of the relationship with the practitioner, the language used, and the amount of information provided can positively alter both patients' outlook on their condition, as well as responses to treatment.[32,40]

This study has several strengths, namely inclusion of several treatment centers, a large sample, a 6M follow-up, examination of various outcome domains, and use of standardized measures. Nevertheless, various limitations must be acknowledged. First, most variables in this study relied on self-report, and although

standardized measures were used, more research is required to establish the psychometric properties of scales assessing global improvement. Moreover, the analyses were correlational in nature. Although SEM analyses illustrate the potential causal relations among the model variables,[50] definitive conclusions about causation can not be drawn. Furthermore, the study was conducted in tertiary care settings, and findings may not be generalizable to the larger population of individuals having chronic pain. Finally, a 6M follow-up period is relatively short; although the data suggest that some changes in outcomes do occur within this period, future studies may consider using repeated measures over longer periods of time.

In conclusion, the present findings help elucidate the link between expectations and clinical outcomes after multidisciplinary chronic pain treatments. This study shows that response to treatment is associated with patient perceptions before and after care. Moreover, the results highlight the importance of eliciting and considering patients' view of the treatment process and of treatment effects. In an effort to increase the effectiveness of multidisciplinary pain programs, more research is needed to further investigate and develop clinical strategies aimed at enhancing expectations and understanding their beneficial effects on pain and health.

Conflict of interest statement

The authors have no conflicts of interest to declare.

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