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painACTION-Back Pain: A Self-Management Website for People with Chronic Back Pain

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Abstract

Objective. To determine whether an interactive self-management Website for people with chronic back pain would significantly improve emotional management, coping, self-efficacy to manage pain, pain levels, and physical functioning compared with standard text-based materials.

Design. The study utilized a pretest–posttest randomized controlled design comparing Website (painACTION-Back Pain) and control (text-based material) conditions at baseline and at 1-, 3, and 6-month follow-ups.

Participants. Two hundred and nine people with chronic back pain were recruited through dissemination of study information online and at a pain treatment clinic. The 6-month follow-up rates for the Website and control groups were 73% and 84%, respectively.

Measurements. Measures were based on the recommendations of the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials and included measures of pain intensity, physical functioning, emotional functioning, coping, self-efficacy, fear-avoidance, perceived improvement with treatment, self-efficacy, and catastrophizing.

Results. Compared with controls, painACTION-Back Pain participants reported significantly: 1) lower stress; 2) increased coping self-statements; and 3) greater use of social support. Comparisons between groups suggested *clinically* significant differences in current pain intensity, depression, anxiety, stress, and global ratings of improvement. Among participants recruited online, those using the Website reported significantly: 1) lower "worst" pain; 2) lower "average" pain; and 3) increased coping self-statements, compared with controls. Participants recruited through the pain clinic evidenced no such differences.

Conclusions. An online self-management program for people with chronic back pain can lead to improvements in stress, coping, and social support, and produce *clinically* significant differences in pain, depression, anxiety, and global rates of improvement.

Key Words. Back Pain; Website; Self-Management; Psychosocial; Tailored; Cognitive Behavior Therapy

Introduction

Chronic low back pain is a prevalent health care problem [1] and is often difficult to treat. Psychological and psychosocial factors complicate the treatment picture—general distress, psychopathology, depression, abuse, and catastrophizing are risk factors for the development and maintenance of chronic pain [2]. This multiplicity of factors has led pain management experts to recommend that interventions for chronic back pain should include significant self-management and cognitive–behavioral therapy (CBT) components, e.g., exercise, pacing activities, relaxation, assertiveness, task persistence, body mechanics, positive self-statements, ignoring pain, and avoiding guarding, catastrophizing, pain-contingent rest, and pain-contingent analgesics [3].

Studies suggest that patients participating in active self-management activities with self-developed action plans experience significantly reduced pain symptoms [4]. Self-management approaches also tend to be low cost and work in diverse populations [5]. Numerous studies have found CBT to be effective in changing a variety of pain-related outcomes, such as catastrophizing, disability, patient functioning, and coping [3,6–8].

Unfortunately, the expansion of self-management programs has been limited by factors such as the lack of trained personnel to teach patients self-management skills and patient–physician relationships based upon patient dependency rather than partnership [4]. In addition,

effective methods such as CBT are not readily available or affordable to the vast majority of patients with chronic back pain [9].

In recent years, there has been considerable interest in using the Internet as an interactive health communication (IHC) medium to deliver interventions to people with chronic illnesses. IHC provides general or individualized health information on demand, can facilitate informed medical decisions, promotes positive health behaviors, offers mutual support to individuals with specific health conditions, and encourages self-management of health problems without direct intervention from a health care professional [10]. In addition, users may provide more candid responses to sensitive health questions posed on a computer, resulting in a more realistic appraisal of problematic health behavior [11,12].

People with chronic illnesses and disabilities have shown great interest in maximizing these advantages. Eighty-seven percent of these individuals have searched for at least one health topic, placing them among the most active "health seekers" on the Internet [13]. To respond to the needs of these individuals, the number of back pain Websites has proliferated. However, the quality is inconsistent, and the information provided is often inadequate [14,15]. Butler and Foster [16] found that more than 75% of the back pain Websites fail to indicate the sources of information. A review of 74 back pain Websites found that about 80% of the sites were focused on advertising, and only seven sites were considered "high quality" by the authors [17]. More recent reviews continue to find that the majority of Websites related to spinal disorders [12] and chronic pain [18] is poor in quality.

Very few back pain Websites have been subjected to empirical scrutiny, but there are several available controlled studies of Internet-based interventions for back pain. These interventions are generally based on self-management strategies and cognitive behavior therapy (CBT) principles [19–21]. A randomized study compared a closed, moderated back pain e-mail discussion group to a subscription to a non-health-related magazine and demonstrated significant improvements in reported pain, disability, role functioning, and health distress, as well as fewer physician visits and hospital days [20]. An evaluation of a 5-month online self-management program for people with back pain found significant decreases in back pain intensity, medical consultation, and use of pain medications, compared with a control group [21]. In a separate study of an 8-week Internet-based cognitive–behavioral intervention with telephone support for people with back pain, significant improvements in catastrophizing, control over pain, and ability to decrease pain were noted in Website participants, compared with a wait-list control group [19]. Improvements were maintained at 3-month follow-up.

This article reports on a study that tested the efficacy of painACTION-Back Pain, an online self-management program for people with chronic back pain. Recent definitions of Internet-supported therapeutic interventions include components such as structured behavior change content, created to alter cognitions and behavior; use of more than one multimedia format; interactivity; and tailored feedback [22]. painACTION-Back Pain was designed with all of these attributes and tested for usability, content, and appearance [23]. We are not aware of any other large randomized trial of an evidenced-based, tailored, Internet-delivered intervention for back pain.

This study examined the hypotheses that, relative to a control condition using standard back pain management text materials, painACTION-Back Pain participants would report significantly: 1) reduced psychological distress; 2) increased use of positive coping strategies; 3) increased self-efficacy to perform pain self-management activities, daily activities, and symptom management strategies; 4) reduced pain; 5) increased physical functioning; and 6) increased patient global impression of positive change (PGIC). Based on recommendations by the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) [24], we also hypothesized that these changes would be *clinically* significant.

Methods

Sample

Inclusion/Exclusion Criteria

The inclusion criteria for study participants were: 1) the presence of back pain for at least 10 days each month for at least three consecutive months immediately prior to participation in the study; 2) spinal origin of pain; and 3) English language fluency (written and spoken). Exclusion criteria included: 1) medical conditions that may explain the back pain and not be spinal in nature (e.g., fibromyalgia, rheumatologic disorders, etc.); 2) cervical pain without low back pain; and 3) psychiatric hospitalization(s) in the past year. Participants were required to have access to a computer and e-mail in order to receive instructions and notifications of assessments.

Recruitment

We recruited participants through two major methods—online dissemination through professional and patient contacts, and staff recruiting at a pain center associated with a large urban medical school. Dissemination was accomplished through: 1) sending letters and follow-up e-mails to members of the American Pain Association; 2) posting on the American Chronic Pain Association Website (membership = 5000); 3) newsletter announcements to health professionals who were registered at PainEDU.org, a continuing education Website for pain management; and 4) posting on Craigslist, a centralized network of online communities.

Interested volunteers called a telephone number provided or sent an e-mail. They were screened for eligibility by a research staff member, who asked in depth about the nature of their back pain, including the: 1) diagnosis

(examples included disk herniation, spinal stenosis, spondylolisthesis, sciatica, fracture, osteoporosis, scoliosis, spondylosis, degenerative disk disease, ankylosing spondylitis); 2) the type of provider who diagnosed the condition; 3) location of their back pain; and 4) their average pain score over the past 90 days (0–10 rating, 0 being "no pain" and 10 being "pain as bad as you can imagine"). If there were questions about whether the participant met medical criteria for the study, one of the authors (a physician who is a pain specialist) was consulted to make an eligibility decision. Those who met study criteria and agreed to participate were e-mailed consent forms and asked to fax, scan, or e-mail the signed consent back in order to be entered into the study. When the informed consent was received, the participant was e-mailed a link to the online baseline assessment.

Screening and informed consent for individuals recruited from the pain clinic was accomplished through face-to-face contact, staff referrals, and the placement of flyers at the clinic. The pain clinic is affiliated with a large urban hospital, so the research protocol and informed consent was approved by the hospital Institutional Review Board (IRB) prior to recruitment at that site. Participants were screened for eligibility by research staff at the clinic using identical procedures as participants recruited through the dissemination and professional contact methods. Those who were eligible to participate were then e-mailed a link to the online baseline assessment by research staff.

Procedures

Randomization Procedure

Participants were e-mailed a link to complete baseline measures online. After completing the baseline measures, participants were randomized to two conditions: 1) Website (painACTION-Back Pain), and 2) control (back pain information only). Participants were randomized using an adaptive or "stratified" randomization that ensures group equivalence on preselected variables that may relate to outcome across conditions [25]. Gender, race/ethnicity, and age bracket (18–40, 41–60, 60 and over) were included in the randomization algorithm.

Conditions

painACTION-Back Pain was designed with input from people with back pain, pain treatment clinicians, and back pain researchers [23]. This Website is based on CBT and self-management principles, and includes components that help people cope with chronic low back pain: 1) collaborative decision making with health professionals; 2) CBT to improve self-efficacy, manage thoughts and mood, set clinical goals, work on problem-solving life situations, and prevent pain relapses; (3) motivational enhancement through tailored feedback; and (4) wellness activities to enhance good sleep, nutrition, stress management, and exercise practices. Information is tailored through a recommendation engine that matches self-reported user characteristics to lessons, interactive tools, personalized assessments, and articles.

Participants in the Website condition were instructed to log onto the painACTION-Back Pain study Website, in their own environment, for two weekly sessions across 4 weeks (total = 8 sessions). Participants were asked to spend at least 20 minutes in each session and were able to spend a longer time if they wished. They followed protocols that served as guides to online content to be reviewed, with instructions for the intervention phase (first 4 weeks) as well as the booster phase (five monthly visits during the follow-up period). Online activities generally revolved around the tailored content presented on the participant's "My Page" through the recommendation engine. The protocols were used as a means to standardize "dosage" (Website usage) among Website participants. At the end of each session, participants indicated completed activities and content viewed in online session logs.

The control group participants were e-mailed a back pain guide (National Institute of Neurological Disorders and Stroke [26]) after baseline. The guide is typical of what is given to patients and covers topics such as the structure of the back, causes and associated conditions, treatments, prevention, practical tips, and additional resources. Control participants were asked to read the guide over a 4-week period. Control participants did not receive a maintenance component.

The Website and control groups completed study measures at four time points—baseline, 1 month post-baseline, 3 months post-baseline, and 6 months post-baseline. Participants received $50 for successful completion of each of the four assessment points, for a total of $200.

Fidelity Monitoring

Recent reviews have focused on the importance of utilizing multiple measures of exposure to assess participant involvement with online interventions [27]. As a means of assuring participant use of the Website, several fidelity monitoring strategies were implemented. Each participant logged in with a personal identification code. Following each session, participants completed an online session log that required completion of a checklist of tasks linked to that session. We tracked completion of session logs to follow which sessions were being completed. In addition, we were able to track each user's session dates and session times (minutes spent) on the Website through usage information on the server. Participants who missed sessions or spent insufficient time were sent e-mail reminders to follow the protocol. Controls participants were not monitored.

Measures

In accordance with recommendations by the IMMPACT [24], we included clinically meaningful measures in pain intensity, physical functioning, emotional functioning, and

a global rating of improvement. In addition, we included measures of coping and cognitive functioning (catastrophizing, self-efficacy, and fear-avoidance).

The following measures were used.

Pain Intensity: Brief Pain Inventory

The Brief Pain Inventory (BPI) [28] is a widely used instrument that assesses pain history, location, intensity, and activity interference on general activity, mood, walking ability, normal work, relations with others, sleep, and enjoyment of life. The BPI discriminates levels of severity and shows sensitivity to change in condition over time in low back pain patients. This study utilized nine pain severity and functional items on this questionnaire.

Physical Functioning: Oswestry Disability Questionnaire

The Oswestry Disability Questionnaire (ODQ) [29] is a widely used self-report questionnaire designed for assessing the degree of functional limitation in patients with low back pain. The scale contains 10 items covering pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and traveling. The ODQ demonstrates factorial and criterion-related validity, and is sensitive to clinical change [30,31].

Emotional Functioning: Depression Anxiety Stress Scales

The Depression Anxiety Stress Scale (DASS) [32] is a 21-item questionnaire that yields three subscale scores: depression, anxiety, and stress. All of these are factors known to be associated with back pain.

Global Rating: PGIC

The PGIC [33] is an outcome measure of global improvement with treatment and consists of a single-item self-rating (7-point scale, "very much improved" to "very much worse") of a participant's perceived improvement with an intervention. The PGIC has been widely used in chronic pain clinical trials (e.g., Guy and Dunkl et al. [34,35]).

Chronic Pain Coping Inventory-42

The Chronic Pain Coping Inventory (CPCI-42) [36,37] is a 42-item self-report measure that asks respondents to rate the frequency of use of behavioral and cognitive coping strategies on eight subscales: guarding, resting, asking for assistance, relaxation, task persistence, exercise/stretching, seeking social support, and coping self-statements. The CPCI-42 demonstrated very high correlations between the original and abbreviated CPCI scales, as well as comparable internal consistency, test–retest stability, and validity coefficients [37].

Pain Catastrophizing Scale

The Pain Catastrophizing Scale (PCS) [38] was developed to assess three components of catastrophizing: rumination, magnification, and helplessness. The scale consists of 13 items rated from 0 to 4 (0 = not at all, 4 = all the time). The PCS showed strong evidence of criterion-related, concurrent, and discriminant validity in a community sample (Sullivan and colleagues [38]).

Pain Self-Efficacy Questionnaire

The Pain Self-Efficacy Questionnaire (PSEQ) [39] consists of 10 items rated from 0 to 6 (0 = not confident at all, 6 = completely confident). The PSEQ measures the strength and generality of a patient's beliefs about performing important coping activities and routines despite the presence of pain. A high score indicates strong self-efficacy beliefs. Studies indicate that the PSEQ correlates highly with pain disability and coping measures, as well as evidences high internal consistency and stability over time [40].

Fear-Avoidance Beliefs Questionnaire

The Fear-Avoidance Beliefs Questionnaire (FABQ) [41] is a 16-item questionnaire, which was developed for patients with low back pain and assesses patients' beliefs about the effects of physical activity and work on pain. The questionnaire consists of two scales, fear-avoidance beliefs about work and fear-avoidance beliefs about physical activity. The two factors on the FABQ have an internal consistency of 0.88 and 0.77, respectively [41].

Demographics Questionnaire

Participants were asked to indicate their age, gender, race, marital status, level of education, current employment status, and annual household income. Demographics were measured only at baseline.

Statistical Analysis

Data analysis was carried out in the following steps: 1) computing descriptive statistics for all demographic variables and testing for differences in demographics between conditions (Website vs control) and participant recruitment source (pain clinic vs Internet); 2) testing for mean differences between conditions over time on each primary outcome (psychological distress, use of positive coping strategies, self-efficacy, pain scores, level of physical function; and participant global impression of change) using linear mixed modeling (LMM); 3) testing for differential Website effects based on participant recruitment source using LMM; and 4) estimating the clinical significance of the study outcomes by comparing changes in groups based on IMMPACT criteria; "clinically significant" was defined as a 10% decrease in pain level, physical impairment, and emotional impairment scores. The percentages of Website and control group participants who experienced at least a "minimally improved" status at

post-intervention were also compared. A mixed model approach was used in steps 2 and 3 because of its ability to handle missing data and to model covariation using flexible covariance structures among repeated measures. Level of significance was set at $\alpha = 0.05$ for each analysis. To maintain an alpha of 0.05 for each statistical test, a Bonferroni correction was applied to all post hoc contrasts; *P* values reported for post hoc comparisons have been Bonferroni corrected unless otherwise noted. All analyses were run using SAS 9.2 (SAS Institute, Cary, NC).

Results

Sample

Participant Inclusion and Attrition

Three hundred and thirty-two participants were screened, and 228 met eligibility criteria and received a baseline assessment. Two hundred and nine returned the baseline assessment and were randomized into the Website (N = 104) and control (N = 105) conditions. Of these, 10 were removed after being found ineligible after completing study measures, resulting in a final study sample of 199 participants (95 Website and 104 control). There were significantly more participants in the Website group (N = 9) who were removed as compared with the control group (N = 1), $P < 0.01$.

Flow Through Study

In accordance with the Consolidated Standards of Reporting Trials group [42], the flow of participants through the study is documented in Figure 1. Because the study was designed with an intent-to-treat approach, the goal was to follow as many participants as possible, regardless of their completion of the interventions.

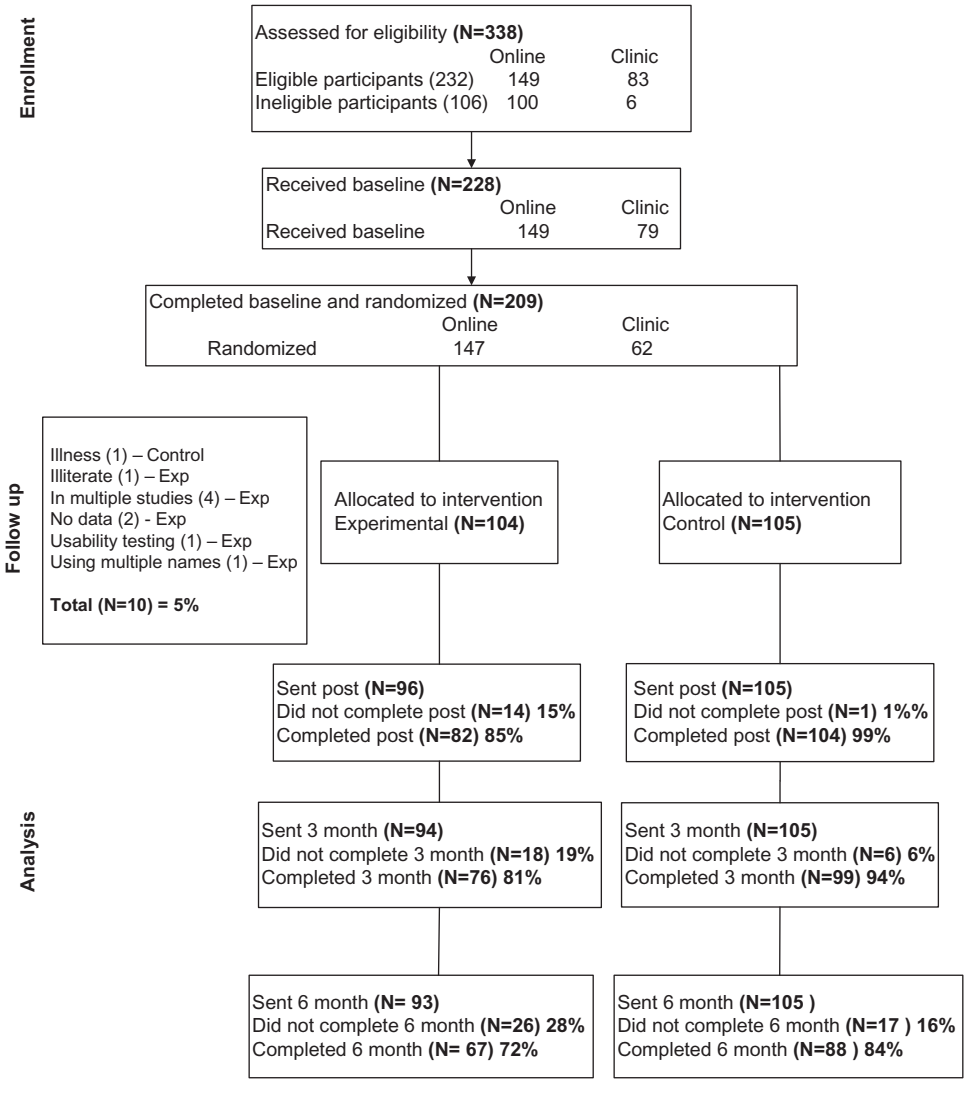

Figure 1 Consolidated Standards of Reporting Trials flow diagram.

Characteristics

Of the 199 participants included in the analysis, 142 participants were recruited online, and 59 participants were recruited via a specialized pain clinic at a hospital in Boston, Massachusetts. Sixty-seven percent were female and 86.4% were white; of the 27 nonwhite participants, 11 reported their race as African American, 11 identified as Hispanic/Latino, and 4 identified as Asian American. The mean age of the sample was M = 46.14 (standard deviation = 11.99) years, with participants' ages ranging from 18 at the youngest to 79 at the oldest. More than half of the sample fell into an annual household income range of $25,000–99,000. At baseline, 34.4% of participants reported their employment status as "full time," while 16.7% worked part time, 32.3% reported their employment status as "disabled," and the remaining 10.1% were unemployed, homemakers, retired, or students. Proportions of employment status differed significantly for controls compared with Website participants ($\chi^2 = 12.61$, $P < 0.05$). No other significant differences in demographics between the control group and the Website group were found. Participants recruited from the pain clinic were more likely to be male (53.5%, compared with 23.6% of the online-recruited sample [$\chi^2 = 16.73$, $P < 0.01$]) and had significantly different distributions of educational attainment ($\chi^2 = 11.51$, $P < 0.05$), race ($\chi^2 = 11.00$, $P < 0.05$), employment status ($\chi^2 = 28.06$, $P < 0.01$), and opioid medication use ($\chi^2 = 9.33$, $P < 0.01$). These results are detailed in Table 1.

Primary Analyses: Treatment Effects

LMMs were run to ascertain whether Website participants, as compared with control participants, evidenced a significantly greater mean change over time on: 1) psychological distress; 2) use of positive coping strategies; 3) self-efficacy; 4) pain scores; 5) level of physical function; and 6) PGIC. The statistical focus of the first five analyses was on the interaction effect, treatment-BY-time, as this effect tests whether or not the Website was more effective than the control condition over time. Significant two-way interactions were followed up by appropriate contrasts. For the analysis of the PGIC, the statistical focus was on mean differences between conditions at each post-baseline time point, because the PGIC asks the participant the extent to which he/she has changed over the course of the study rather than current status. The results of these analyses are presented in Table 2.

LMMs were also run to test for differential effects of treatment depending on participant recruitment source (online vs pain clinic). The statistical focus of these analyses was the three-way interaction, treatment-BY-time-BY-source, which was followed up by appropriate contrasts. The results of these analyses are presented in Tables 3 and 4.

We also present comparisons in outcomes (degree of change from baseline to post-intervention) between the Website and control groups. These results can be found in Table 5.

Decreased Psychological Distress

In order to assess change in participants' psychological/emotional functioning, LMMs were run to test for the effect of the Website intervention compared with the control condition over time on each of the three subscales of the DASS. Results revealed a significant effect of treatment over time for the stress subscale of the DASS ($F_{3, 197} = 3.92$, $P < 0.01$). Post hoc tests revealed that, compared with the control group, participants who used the Website reported significantly lower stress from baseline to 3-month follow-up ($t = 3.23$, $P < 0.01$) and 6-month follow-up ($t = 2.65$, $P < 0.05$). No statistically significant effects of condition over time were noted for fear-avoidance behaviors, or for the depression or anxiety subscales of the DASS (see Table 2). A comparison of study findings with IMMPACT criteria suggested that Website participants showed evidence of clinically significant decreases in depression (15.5% decrease), anxiety (20.1% decrease), and stress (16.5% decrease) from baseline to post-intervention (see Table 5).

Increased Use of Positive Coping Strategies

Based on a LMM, a significant interaction effect of treatment-BY-time was noted for the coping subscale of the CPCI, $F_{3, 197} = 4.07$, $P < 0.01$; compared with the control group, Website participants had a significantly greater increased use of coping self-statements from baseline to posttest ($t = –2.67$, $P < 0.05$), 3-month follow-up ($t = –3.19$, $P < 0.01$), and 6-month follow-up ($t = –2.44$, $P < 0.05$). A significant effect of treatment over time was also noted for the social supports subscale of the CPCI, $F_{3, 197} = 2.99$, $P < 0.05$; participants who used the Website reported significantly greater use of social supports from baseline to 6-month follow-up ($t = –2.89$, $P < 0.05$), compared with controls (see Table 2).

A significant three-way interaction was noted for the "coping" subscale of the CPCI, $F_{3, 195} = 3.03$, $P < 0.05$. Participants recruited online demonstrated an increase in coping self-statements from baseline to three-month follow-up ($t = –3.74$, $P < 0.01$) and an increase from baseline to six-month follow-up ($t = –2.66$, $P < 0.05$); no differences were seen amongst participants recruited from the pain clinic (see Tables 3 and 4).

Increased Self-Efficacy

A LMM was also run to test for a significant effect of condition-BY-time on self-efficacy as measured by the PSEQ; no significant differences in mean self-efficacy change were noted for Website participants over time, compared with the control group.

Reduction in Pain

The effect of the Website intervention compared with the control condition over time was examined for participants' self-reported "worst pain," "least pain," "average pain,"

Table 1 Baseline demographic characteristics for 199 study participants

	Total N = 199	Control N = 104	Experimental N = 95	Test Statistic*	$P^{\dagger}$	Clinic N = 59	Online N = 140	Test Statistic*	$P^{\ddagger}$
Age[§]	46.14 (11.99)	45.05 (11.72)	47.34 (12.23)	−1.35	0.1794	47.53 (12.17)	45.56 (11.91)	1.06	0.2915
Gender[¶]									
Male	64 (32.32)	33 (32.04)	31 (32.63)	0.01	0.9290	31 (53.45)	33 (23.57)	16.73	<0.0001
Female	134 (67.68)	70 (67.96)	64 (67.37)			27 (46.55)	107 (76.43)		
Marital status									
Single	47 (23.74)	24 (23.30)	23 (24.21)	6.68	0.3514	17 (29.31)	30 (21.43)	3.70	0.7176
Married	104 (52.53)	60 (58.25)	44 (46.32)			27 (46.55)	77 (55.00)		
Separated	4 (2.02)	1 (0.97)	3 (3.16)			2 (3.45)	2 (1.43)		
Widowed	5 (2.53)	1 (0.97)	4 (4.21)			2 (3.45)	3 (2.14)		
Divorced	23 (11.62)	12 (11.65)	11 (11.58)			7 (12.07)	16 (11.43)		
Remarried	3 (1.52)	1 (0.97)	2 (2.11)			1 (1.72)	2 (1.43)		
Living with partner	12 (6.06)	4 (3.88)	8 (8.42)			2 (3.45)	10 (7.14)		
Education									
<11th grade	2 (1.01)	1 (0.97)	1 (1.05)	2.04	0.8430	1 (1.72)	1 (0.71)	11.51	0.0421
HS or GED	50 (25.25)	24 (23.30)	26 (27.37)			22 (37.93)	28 (20.00)		
Partial college/AA	63 (31.82)	35 (33.98)	28 (29.47)			19 (32.76)	44 (31.43)		
BA or BS	55 (27.78)	31 (30.10)	24 (25.26)			12 (20.69)	43 (30.71)		
Master's	26 (13.13)	11 (10.68)	15 (15.79)			3 (5.17)	23 (16.43)		
PhD/MD	2 (1.01)	1 (0.97)	1 (1.05)			1 (1.72)	1 (0.71)		
Race									
White non-Hispanic	171 (86.36)	90 (87.38)	81 (85.26)	7.53	0.1106	48 (82.76)	123 (87.86)	11.00	0.0265
African American	11 (5.56)	3 (3.88)	8 (8.42)			7 (12.07)	4 (2.86)		
Asian American	4 (2.02)	4 (3.88)	0 (0.00)			1 (1.72)	3 (2.14)		
Hispanic/Latino	11 (5.56)	6 (5.83)	5 (5.26)			1 (1.72)	10 (7.14)		
Other	1 (0.51)	0 (0.00)	1 (1.05)			1 (1.72)	0 (0.00)		
Income ($)									
24,999 or less	36 (18.18)	16 (15.53)	20 (21.05)	4.85	0.6787	14 (24.14)	22 (15.71)	10.07	0.1846
25,000–49,999	39 (19.70)	16 (15.53)	23 (58.97)			12 (20.69)	27 (19.29)		
50,000–74,999	33 (16.67)	19 (18.45)	14 (14.74)			5 (8.62)	28 (20.00)		
75,000–99,999	36 (18.18)	22 (21.36)	14 (14.74)			9 (15.52)	27 (19.29)		
100,000–149,999	24 (12.12)	14 (13.59)	10 (10.53)			8 (13.79)	16 (11.43)		
150,000–199,999	8 (4.04)	4 (3.88)	4 (4.21)			2 (3.45)	6 (4.29)		
200,000 or more	5 (2.53)	3 (2.91)	2 (2.11)			0 (0.00)	5 (3.57)		
I choose not to answer	17 (8.59)	9 (8.74)	8 (8.42)			8 (13.79)	9 (6.43)		
Employment									
Employed FT	69 (34.85)	32 (31.07)	37 (38.95)	12.61	0.0497	12 (20.69)	57 (40.71)	28.06	<0.0001
Employed PT	33 (16.67)	20 (19.42)	13 (13.68)			4 (6.90)	29 (20.71)		
Unemployed	6 (3.03)	2 (1.94)	4 (4.21)			2 (3.45)	4 (2.86)		
Disabled	64 (32.32)	33 (32.04)	31 (32.63)			34 (58.62)	30 (21.43)		
Homemaker	12 (6.06)	11 (10.68)	1 (1.05)			2 (3.45)	10 (7.14)		
Retired	8 (4.04)	2 (1.94)	6 (6.32)			2 (3.45)	6 (4.29)		
Student	6 (3.03)	3 (2.91)	3 (3.16)			2 (3.45)	4 (2.86)		
Opioid medication									
Yes	162 (81.82)	85 (82.52)	77 (81.05)	0.07	0.7885	55 (94.83)	107 (74.43)	9.33	0.0023
No	36 (18.18)	18 (17.48)	18 (18.95)			3 (5.17)	33 (23.57)		
Recruitment									
Online	140 (70.4)	72 (69.2)	68 (71.6)	0.13	0.7171	—	—		
Clinic	59 (29.7)	32 (30.8)	27 (28.4)			—	—		

* Test statistic is *t* for continuous variables and χ^2 for categorical variables, comparing experimental and control groups.
† *P* is for *t*-test for continuous variables and chi-square test for categorical variables, comparing experimental and control groups.
‡ *P* is for *t*-test for continuous variables and chi-square test for categorical variables, comparing online- and clinic-recruited groups.
§ Values given are mean (standard deviation).
¶ Values given are N (%).
HS = high school, GED = General Educational Development Diploma, AA = Associates degree, BA = Bachelor of Arts degree, BS = Bachelor of Science degree, FT = full-time, PT = part-time.

Table 2 LS means and standard errors for all outcome measures

	Control N = 104				Experimental N = 95			
	Baseline	Post	3-month	6-month	Baseline	Post	3-month	6-month
BPI								
Worst*	6.96 (0.17)	6.75 (0.21)	6.82 (0.23)	6.65 (0.25)	7.08 (0.18)	6.53 (0.23)	6.42 (0.26)	6.51 (0.28)
Least	3.93 (0.22)	3.66 (0.22)	3.89 (0.26)	3.70 (0.23)	3.52 (0.23)	3.37 (0.24)	3.60 (0.23)	2.86 (0.25)
Average*	5.59 (0.17)	5.35 (0.19)	5.44 (0.19)	5.18 (0.22)	5.57 (0.18)	5.13 (0.20)	5.04 (0.21)	4.78 (0.25)
Current	5.56 (0.22)	5.17 (0.23)	5.45 (0.24)	5.26 (0.28)	5.29 (0.23)	4.64 (0.26)	4.47 (0.27)	4.39 (0.31)
Relief	46.29 (2.52)	47.10 (2.48)	47.58 (2.64)	47.03 (2.93)	50.63 (2.63)	49.27 (2.80)	52.09 (2.99)	49.88 (3.29)
Interference	5.76 (0.23)	5.03 (0.26)	5.00 (0.26)	4.78 (0.29)	5.46 (0.24)	4.70 (0.29)	4.65 (0.29)	4.95 (0.32)
CPCI								
Assistance	3.05 (0.21)	3.08 (0.19)	3.04 (0.21)	3.29 (0.23)	2.69 (0.22)	2.59 (0.21)	2.86 (0.23)	3.16 (0.26)
Coping*	4.09 (0.19)	4.23 (0.19)	4.03 (0.20)	4.10 (0.22)	3.71 (0.20)[abc]	4.50 (0.21)[a]	4.50 (0.22)[b]	4.51 (0.25)[c]
Exercise	3.06 (0.20)	3.64 (0.19)	3.46 (0.20)	3.29 (0.22)	2.78 (0.20)	3.43 (0.21)	3.26 (0.22)	3.47 (0.25)
Guarding	3.77 (0.18)	3.46 (0.17)	3.41 (0.19)	3.38 (0.21)	3.69 (0.19)	3.23 (0.18)	3.33 (0.21)	3.59 (0.23)
Persistence	3.64 (0.16)	3.87 (0.16)	3.88 (0.15)	3.85 (0.18)	3.54 (0.17)	3.91 (0.18)	3.82 (0.17)	3.87 (0.20)
Relaxation	2.34 (0.18)	2.66 (0.18)	2.53 (0.18)	2.64 (0.20)	2.34 (0.18)	2.93 (0.19)	3.05 (0.20)	3.19 (0.22)
Resting	3.98 (0.18)	3.86 (0.17)	3.81 (0.19)	4.13 (0.19)	4.15 (0.19)	4.03 (0.18)	3.97 (0.21)	4.42 (0.21)
Social	2.72 (0.19)	2.86 (0.19)	2.78 (0.20)	2.73 (0.21)	2.54 (0.20)[a]	3.09 (0.21)	3.08 (0.22)	3.33 (0.24)[a]
DASS								
Anxiety	8.63 (0.82)	8.42 (0.89)	7.87 (0.78)	8.32 (0.84)	9.66 (0.85)	7.72 (0.98)	7.24 (0.86)	7.22 (0.92)
Depression	12.60 (1.09)	11.44 (0.98)	11.72 (1.02)	12.65 (1.12)	13.20 (1.14)	11.15 (1.08)	10.07 (1.13)	10.55 (1.24)
Stress	14.20 (0.90)	14.30 (0.94)	13.98 (0.88)	14.54 (0.96)	15.07 (0.94)[abc]	12.58 (1.03)[a]	11.16 (0.97)[b]	11.89 (1.07)[c]
FAB								
Physical activity	15.35 (0.59)	15.00 (0.61)	14.46 (0.63)	14.80 (0.78)	15.89 (0.61)	14.15 (0.67)	13.93 (0.70)	14.80 (0.78)
Work	20.49 (1.32)	18.32 (1.39)	18.98 (1.37)	19.21 (1.42)	19.83 (1.38)	19.84 (1.50)	19.94 (1.49)	19.85 (1.55)
ODQ								
Pain intensity	2.37 (0.09)	2.14 (0.10)	2.19 (0.11)	2.13 (0.12)	2.26 (0.10)	2.14 (0.11)	2.03 (0.12)	2.12 (0.13)
Personal care	1.37 (0.12)	1.29 (0.10)	1.12 (0.10)	1.23 (0.12)	1.32 (0.12)	1.08 (0.11)	1.28 (0.12)	1.12 (0.13)
Lifting	2.96 (0.12)	2.75 (0.13)	2.88 (0.13)	2.73 (0.13)	3.14 (0.13)	2.67 (0.14)	2.89 (0.15)	3.09 (0.15)
Walking	1.76 (0.13)	1.70 (0.12)	1.64 (0.12)	1.83 (0.14)	1.68 (0.13)	1.74 (0.13)	1.72 (0.14)	1.84 (0.16)
Sitting	2.20 (0.10)	2.13 (0.10)	2.11 (0.10)	2.19 (0.12)	2.12 (0.11)	2.03 (0.11)	2.10 (0.11)	1.94 (0.13)
Standing	2.53 (0.12)	2.55 (0.12)	2.62 (0.12)	2.51 (0.13)	2.62 (0.12)	2.47 (0.13)	2.54 (0.14)	2.67 (0.15)
Sleeping	1.91 (0.11)	1.92 (0.11)	1.77 (0.11)	2.00 (0.12)	1.84 (0.11)	1.98 (0.12)	1.94 (0.12)	1.91 (0.13)
Sex life	3.55 (0.23)	3.29 (0.22)	3.27 (0.24)	3.26 (0.26)	3.36 (0.24)	2.88 (0.25)	3.02 (0.27)	3.21 (0.29)
Social life	2.41 (0.13)	2.32 (0.14)	2.31 (0.14)	2.34 (0.15)	2.49 (0.13)	2.30 (0.15)	2.23 (0.15)	2.27 (0.16)
Traveling	2.08 (0.12)	1.95 (0.12)	2.01 (0.12)	2.13 (0.13)	2.02 (0.13)	1.93 (0.13)	1.90 (0.13)	1.96 (0.14)
Total score	46.36 (1.64)	44.09 (1.72)	43.85 (0.79)	44.53 (1.87)	45.69 (1.77)	42.62 (1.88)	43.35 (1.97)	44.51 (2.08)
PSEQ								
Total	30.79 (1.45)	33.35 (1.49)	32.55 (1.52)	33.17 (1.62)	30.81 (1.52)	34.09 (1.61)	33.50 (1.65)	33.87 (1.76)
PCS								
Magnification	5.13 (0.29)	4.34 (0.29)	4.38 (0.30)	4.15 (0.34)	4.28 (0.30)	3.18 (0.32)	2.94 (0.33)	3.27 (0.37)
Helplessness	10.34 (0.55)	9.15 (0.57)	8.71 (0.57)	9.05 (0.64)	8.97 (0.58)	6.21 (0.63)	6.31 (0.63)	6.16 (0.70)
Rumination	8.40 (0.42)	7.58 (0.43)	7.14 (0.45)	7.56 (0.50)	7.21 (0.44)	5.53 (0.48)	5.48 (0.50)	5.05 (0.56)
Total	23.86 (1.13)	21.08 (1.19)	20.24 (1.23)	20.76 (1.36)	20.46 (1.18)	14.92 (1.30)	14.77 (1.36)	14.52 (1.51)
PGIC								
Improvement	—	3.82 (0.10)[a]	3.45 (0.10)[b]	3.46 (0.13)[c]	—	3.37 (0.11)[a]	3.02 (0.12)[b]	2.89 (0.15)[c]

Pairwise post hoc contrasts between experimental and control groups at each time point for PGIC and for the mean change in differences for all other outcomes.

* Significant moderating effects of participant recruitment source were noted for these outcomes.

† Questions about opioid medication safety were limited to participants who reported using opioid medications at baseline (N = 162).

[abc] Unique superscripts indicate significant pairwise post hoc tests (Bonferroni-adjusted $P < 0.05$).

LS = Least Squares Means; BPI = Brief Pain Inventory; CPCI = Chronic Pain Coping Inventory; DASS = Depression Anxiety Stress Scale; FAB = Fear-Avoidance Beliefs; ODQ = Oswestry Disability Questionnaire; PSEQ = Pain Self-Efficacy Questionnaire; PCS = Pain Catastrophizing Scale; PGIC = Patients Global Impression of Change.

Table 3 LS means and standard errors for all outcome measures for participants recruited online

	Control N = 72				Experimental N = 68			
	Baseline	Post	3-month	6-month	Baseline	Post	3-month	6-month
BPI								
Worst	6.74 (0.21)	6.64 (0.25)	6.54 (0.27)	6.15 (0.29)	7.04 (0.21)[a]	6.14 (0.26)[a]	6.06 (0.29)	6.39 (0.31)
Least	3.75 (0.26)	3.67 (0.27)	3.76 (0.30)	3.45 (0.27)	3.32 (0.27)	3.06 (0.28)	3.16 (0.33)	2.54 (0.29)
Average	5.61 (0.21)	5.38 (0.22)	5.45 (0.23)	5.92 (0.39)	5.47 (0.21)[a]	4.91 (0.24)	4.67 (0.24)[a]	4.57 (0.28)
Current	5.53 (0.26)	5.26 (0.28)	5.29 (0.29)	4.90 (0.33)	5.15 (0.27)	4.27 (0.30)	4.08 (0.31)	4.03 (0.35)
Relief	43.89 (3.01)	45.97 (2.96)	48.34 (3.12)	48.31 (3.49)	48.38 (3.09)	51.62 (3.21)	55.70 (3.38)	52.55 (3.75)
Interference	5.77 (0.28)	5.10 (0.32)	4.82 (0.31)	4.42 (0.34)	5.50 (0.29)	4.53 (0.34)	4.45 (0.33)	4.76 (0.36)
CPCI								
Assistance	3.06 (0.25)	3.14 (0.23)	3.14 (0.25)	3.16 (0.28)	2.72 (0.26)	2.39 (0.24)	2.85 (0.27)	3.05 (0.30)
Coping	4.26 (0.22)	4.49 (0.23)	4.12 (0.24)	4.16 (0.27)	3.62 (0.23)[ab]	4.40 (0.25)	4.64 (0.26)[a]	4.54 (0.29)[b]
Exercise	3.17 (0.23)	3.77 (0.22)	3.48 (0.24)	3.22 (0.27)	2.65 (0.24)	3.52 (0.24)	3.32 (0.25)	3.63 (0.29)
Guarding	3.57 (0.21)	3.31 (0.20)	3.25 (0.23)	3.11 (0.25)	3.57 (0.22)	3.10 (0.21)	3.20 (0.24)	3.59 (0.26)
Persistence	3.68 (0.19)	4.02 (0.20)	4.01 (0.18)	4.10 (0.22)	3.51 (0.20)	3.84 (0.21)	3.80 (0.20)	3.95 (0.23)
Relaxation	2.49 (0.21)	2.85 (0.21)	2.69 (0.21)	2.71 (0.21)	2.41 (0.22)	3.11 (0.22)	3.22 (0.23)	3.25 (0.26)
Resting	3.79 (0.22)	3.76 (0.20)	3.77 (0.23)	3.93 (0.23)	4.06 (0.23)	3.94 (0.21)	3.81 (0.24)	4.29 (0.24)
Social	2.64 (0.23)	2.84 (0.23)	2.73 (0.24)	2.73 (0.26)	2.66 (0.24)	3.20 (0.24)	3.08 (0.26)	3.33 (0.28)
DASS								
Anxiety	8.75 (0.99)	8.94 (1.07)	8.22 (0.93)	8.84 (1.01)	9.47 (1.01)	6.90 (1.14)	6.58 (1.00)	6.77 (1.07)
Depression	12.69 (1.32)	11.36 (1.19)	11.61 (1.23)	11.82 (1.34)	13.44 (1.35)	10.90 (1.26)	9.56 (1.31)	9.80 (1.43)
Stress	14.44 (1.09)	15.19 (1.13)	14.80 (1.05)	14.55 (1.15)	15.21 (1.12)	11.87 (1.20)	10.38 (1.12)	11.08 (1.23)
FAB								
Physical activity	14.42 (0.69)	14.35 (0.73)	14.05 (0.76)	13.53 (0.84)	16.31 (0.71)	14.10 (0.78)	14.07 (0.82)	14.80 (0.90)
Work	18.21 (1.56)	15.24 (1.61)	16.13 (1.60)	16.48 (1.67)	18.41 (1.60)	18.21 (1.70)	18.66 (1.69)	18.85 (1.77)
ODQ								
Pain intensity	2.35 (0.11)	2.10 (0.11)	2.11 (0.13)	2.06 (0.14)	2.18 (0.12)	2.05 (0.12)	1.89 (0.14)	1.95 (0.15)
Personal care	1.36 (0.14)	1.24 (0.12)	1.12 (0.13)	1.19 (0.14)	1.44 (0.14)	1.11 (0.13)	1.28 (0.13)	1.13 (0.15)
Lifting	2.93 (0.14)	2.67 (0.15)	2.71 (0.15)	2.60 (0.16)	3.16 (0.15)	2.68 (0.16)	3.03 (0.17)	3.14 (0.17)
Walking	1.65 (0.15)	1.58 (0.15)	1.52 (0.15)	1.75 (0.17)	1.68 (0.16)	1.75 (0.15)	1.62 (0.16)	1.87 (0.18)
Sitting	2.07 (0.12)	2.06 (0.12)	1.99 (0.12)	2.14 (0.14)	2.09 (0.12)	1.99 (0.12)	2.07 (0.13)	1.97 (0.15)
Standing	2.46 (0.14)	2.46 (0.14)	2.53 (0.15)	2.34 (0.15)	2.63 (0.14)	2.43 (0.15)	2.48 (0.16)	2.62 (0.17)
Sleeping	1.81 (0.13)	1.86 (0.13)	1.69 (0.13)	1.94 (0.14)	1.76 (0.13)	1.93 (0.14)	1.81 (0.14)	1.81 (0.16)
Sex life	3.58 (0.28)	3.89 (0.27)	3.34 (0.28)	3.22 (0.31)	3.13 (0.29)	2.66 (0.29)	2.70 (0.31)	2.68 (0.33)
Social life	2.46 (0.15)	2.24 (0.17)	2.22 (0.17)	2.20 (0.18)	2.46 (0.16)	2.15 (0.18)	2.07 (0.18)	2.09 (0.19)
Traveling	2.04 (0.14)	2.00 (0.14)	1.98 (0.14)	1.96 (0.15)	2.09 (0.15)	1.92 (0.15)	1.91 (0.15)	2.06 (0.16)
Total score	45.59 (1.98)	43.17 (2.07)	42.47 (2.14)	42.66 (2.22)	45.25 (2.10)	41.42 (2.21)	41.76 (2.29)	42.87 (2.39)
PSEQ								
Total	31.92 (1.74)	34.19 (1.78)	33.74 (1.81)	35.64 (1.89)	31.94 (1.79)	35.08 (1.88)	34.93 (1.91)	35.78 (2.00)
PCS								
Magnification	5.35 (0.34)	4.36 (0.35)	4.32 (0.36)	3.90 (0.41)	4.25 (0.35)	3.03 (0.37)	2.71 (0.39)	3.17 (0.43)
Helplessness	10.47 (0.66)	8.76 (0.69)	8.50 (0.68)	8.59 (0.76)	9.12 (0.68)	5.77 (0.73)	5.53 (0.73)	5.58 (0.81)
Rumination	8.74 (0.51)	7.65 (0.52)	7.09 (0.53)	7.43 (0.60)	7.32 (0.52)	5.32 (0.56)	5.10 (0.57)	4.64 (0.64)
Total	24.56 (1.36)	20.78 (1.44)	19.92 (1.47)	19.94 (1.63)	20.69 (1.40)	14.07 (1.52)	13.36 (1.57)	13.4 (1.74)
PGIC								
Improvement	—	3.85 (0.12)[a]	3.35 (0.12)[b]	3.10 (0.15)	—	3.25 (0.13)[a]	2.85 (0.13)[b]	2.76 (0.16)

Pairwise post hoc contrasts between experimental and control groups at each time point for PGIC and for the mean change in differences for all other outcomes.

* Questions about opioid medication safety were limited to participants who reported using opioid medications at baseline (N = 162).

[abc] Unique superscripts indicate significant pairwise post hoc tests (Bonferroni-adjusted $P < 0.05$).

LS = Least Squares Means; BPI = Brief Pain Inventory; CPCI = Chronic Pain Coping Inventory; DASS = Depression Anxiety Stress Scale; FAB = Fear-Avoidance Beliefs; ODQ = Oswestry Disability Questionnaire; PSEQ = Pain Self-Efficacy Questionnaire; PCS = Pain Catastrophizing Scale; PGIC = Patients Global Impression of Change.

Table 4 LS means and standard errors for all outcome measures for participants recruited through pain clinic

	Control N = 32				Experimental N = 27			
	Baseline	Post	3-month	6-month	Baseline	Post	3-month	6-month
BPI								
Worst	7.45 (0.31)	7.00 (0.37)	7.46 (0.41)	7.82 (0.44)	7.19 (0.34)	7.80 (0.46)	7.54 (0.52)	6.88 (0.55)
Least	4.34 (0.40)	3.64 (0.40)	4.19 (0.46)	4.26 (0.41)	4.00 (0.43)	4.27 (0.48)	4.94 (0.57)	3.85 (0.51)
Average	5.53 (0.31)	5.29 (0.34)	5.42 (0.34)	5.92 (0.39)	5.81 (0.34)	5.80 (0.40)	6.20 (0.41)	5.45 (0.49)
Current	5.64 (0.39)	4.96 (0.42)	5.83 (0.44)	6.10 (0.50)	5.67 (0.43)	5.77 (0.51)	5.70 (0.54)	5.46 (0.62)
Relief	51.85 (4.56)	49.66 (4.50)	45.59 (4.77)	43.80 (5.33)	56.30 (4.91)	40.88 (5.63)	39.17 (6.07)	40.69 (6.68)
Interference	5.73 (0.42)	4.87 (0.48)	5.41 (0.47)	5.62 (0.52)	5.36 (0.46)	5.26 (0.57)	5.34 (0.58)	5.58 (0.63)
CPCI								
Assistance	3.03 (0.38)	2.95 (0.35)	2.80 (0.38)	3.59 (0.43)	2.62 (0.41)	3.25 (0.41)	2.89 (0.47)	3.53 (0.53)
Coping	3.71 (0.34)	3.62 (0.35)	3.82 (0.36)	3.97 (0.41)	3.93 (0.37)	4.77 (0.43)	3.99 (0.45)	4.40 (0.51)
Exercise	2.83 (0.35)	3.34 (0.34)	3.42 (0.36)	3.46 (0.41)	3.12 (0.38)	3.09 (0.41)	3.03 (0.44)	2.89 (0.51)
Guarding	4.20 (0.32)	3.81 (0.30)	3.75 (0.34)	4.01 (0.37)	3.98 (0.35)	3.59 (0.36)	3.72 (0.41)	3.49 (0.45)
Persistence	3.56 (0.29)	3.52 (0.30)	3.56 (0.28)	3.27 (0.33)	3.61 (0.31)	4.11 (0.36)	3.91 (0.34)	3.57 (0.41)
Relaxation	2.00 (0.32)	2.22 (0.32)	2.17 (0.33)	2.49 (0.37)	2.15 (0.34)	2.36 (0.38)	2.51 (0.40)	3.02 (0.45)
Resting	4.42 (0.33)	4.09 (0.30)	3.87 (0.34)	4.58 (0.34)	4.37 (0.36)	4.27 (0.36)	4.42 (0.42)	4.77 (0.42)
Social	2.90 (0.35)	2.90 (0.34)	2.91 (0.37)	2.73 (0.39)	2.23 (0.38)	2.81 (0.42)	3.12 (0.46)	3.37 (0.48)
DASS								
Anxiety	8.40 (1.49)	7.22 (1.62)	7.06 (1.42)	7.10 (1.53)	10.15 (1.61)	10.31 (1.92)	9.28 (1.71)	8.59 (1.85)
Depression	12.36 (1.99)	11.62 (1.79)	11.97 (1.87)	14.61 (2.04)	12.59 (2.15)	12.09 (2.14)	11.86 (2.24)	13.10 (2.48)
Stress	13.68 (1.64)	12.24 (1.70)	12.08 (1.60)	14.57 (1.75)	14.74 (1.78)	14.99 (2.05)	13.75 (1.94)	14.62 (2.16)
FAB								
Physical activity	17.48 (1.05)	16.45 (1.10)	15.35 (1.16)	16.40 (1.28)	14.85 (1.13)	14.56 (1.34)	13.68 (1.43)	15.03 (1.58)
Work	25.59 (2.34)	25.33 (2.43)	25.50 (2.42)	25.43 (2.53)	23.41 (2.54)	24.15 (2.83)	23.16 (2.87)	22.29 (3.05)
ODQ								
Pain intensity	2.40 (0.17)	2.24 (0.17)	2.39 (0.19)	2.31 (0.21)	2.48 (0.18)	2.41 (0.21)	2.43 (0.24)	2.63 (0.26)
Personal care	1.38 (0.21)	1.42 (0.19)	1.14 (0.19)	1.33 (0.21)	1.00 (0.23)	1.02 (0.22)	1.36 (0.23)	1.14 (0.27)
Lifting	3.03 (0.22)	2.95 (0.23)	3.28 (0.24)	3.09 (0.24)	3.07 (0.24)	2.63 (0.28)	2.42 (0.29)	2.93 (0.30)
Walking	2.00 (0.23)	1.98 (0.22)	1.90 (0.22)	2.01 (0.26)	1.70 (0.25)	1.73 (0.26)	2.05 (0.27)	1.74 (0.32)
Sitting	2.51 (0.18)	2.31 (0.18)	2.39 (0.19)	2.33 (0.22)	2.19 (0.20)	2.16 (0.21)	2.20 (0.23)	1.85 (0.27)
Standing	2.69 (0.21)	2.76 (0.22)	2.83 (0.23)	2.90 (0.24)	2.59 (0.23)	2.62 (0.26)	2.75 (0.27)	2.80 (0.29)
Sleeping	2.15 (0.20)	2.04 (0.20)	1.93 (0.20)	2.13 (0.22)	2.04 (0.21)	2.10 (0.24)	2.35 (0.25)	2.20 (0.27)
Sex life	3.47 (0.42)	3.07 (0.41)	3.12 (0.43)	3.30 (0.47)	3.93 (0.45)	3.51 (0.50)	3.95 (0.54)	4.85 (0.58)
Social life	2.28 (0.23)	2.50 (0.26)	2.54 (0.25)	2.66 (0.27)	2.59 (0.25)	2.80 (0.30)	2.71 (0.30)	2.79 (0.32)
Traveling	2.18 (0.22)	1.84 (0.22)	2.06 (0.22)	2.50 (0.23)	1.85 (0.24)	2.01 (0.26)	1.93 (0.27)	1.63 (0.29)
Total score	48.08 (2.98)	46.20 (3.11)	42.47 (2.14)	48.85 (3.37)	46.80 (3.36)	46.24 (3.63)	48.28 (3.83)	49.52 (4.09)
PSEQ								
Total	28.28 (2.63)	31.45 (2.69)	29.85 (2.74)	27.51 (2.86)	27.96 (2.84)	31.56 (3.12)	34.93 (1.91)	28.28 (3.41)
PCS								
Magnification	4.62 (0.52)	4.31 (0.53)	4.54 (0.55)	4.74 (0.62)	4.37 (0.56)	3.66 (0.64)	3.68 (0.67)	3.54 (0.74)
Helplessness	10.03 (1.01)	10.04 (1.04)	9.20 (1.04)	10.13 (1.16)	8.59 (1.09)	7.75 (1.24)	8.90 (1.26)	8.09 (1.41)
Rumination	7.62 (0.77)	7.44 (0.79)	7.28 (0.81)	7.88 (0.91)	6.93 (0.83)	6.27 (0.96)	6.73 (0.99)	6.43 (1.14)
Total	22.24 (2.06)	21.81 (2.17)	21.03 (2.23)	22.69 (2.48)	19.89 (2.23)	17.83 (2.58)	19.47 (2.70)	18.23 (3.01)
PGIC								
Improvement	—	3.76 (0.18)	3.68 (0.18)	4.26 (0.22)	—	3.73 (0.23)	3.56 (0.24)	3.33 (0.29)

Pairwise post hoc contrasts between experimental and control groups at each time point for PGIC and for the mean change in differences for all other outcomes.

* Questions about opioid medication safety were limited to participants who reported using opioid medications at baseline (N = 162).

[abc] Unique superscripts indicate significant pairwise post hoc tests (Bonferroni-adjusted $P < 0.05$). LS = Least Squares Means; BPI = Brief Pain Inventory; CPCI = Chronic Pain Coping Inventory; DASS = Depression Anxiety Stress Scale; FAB = Fear-Avoidance Beliefs; ODQ = Oswestry Disability Questionnaire; PSEQ = Pain Self-Efficacy Questionnaire; PCS = Pain Catastrophizing Scale; PGIC = Patients Global Impression of Change.

Table 5 Study results according to IMMPACT criteria

		Experimental Measure	Control Measure
Pain intensity	BPI worst pain*	7.8% decrease	3% decrease
	BPI least pain*	4.3% decrease	6.9% decrease
	BPI average pain*	7.9% decrease	4.3% decrease
	BPI current pain*	12.3% decrease§	7.0% decrease
Physical functioning	Oswestry*	6.7% decrease	4.9% decrease
	BPI interference†	0.76 point decrease	0.73 point decrease
Emotional functioning	DASS depression*	15.5% decrease§	9.2% decrease
	DASS anxiety*	20.1% decrease§	2.4% decrease
	DASS stress*	16.5% decrease§	0.7% increase
Global rating of improvement	Very much improved‡	1 (1.32%)	2 (1.94%)
	Much improved‡	11 (14.47%)	7 (6.80%)
	Minimally improved‡	31 (40.79%)	25 (24.27%)
	No change‡	27 (35.53%)	51 (49.51%)
	Minimally worse‡	5 (6.58%)	11 (10.68%)
	Much worse‡	1 (1.32%)	5 (4.85%)
	Very much worse‡	0 (0.0%)	2 (1.94%)

* Calculated as: ([baseline group average – post-intervention group average]/baseline group average) × 100.
† Calculated as: (baseline group average – post-intervention group average).
‡ Participants who endorsed each category, given as N (%).
§ Met 10% criterion for clinically significant reduction.
IMMPACT = Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials; BPI = Brief Pain Inventory; DASS = Depression Anxiety Stress Scale.

and "current pain" levels. No statistically significant difference between conditions over time was noted for self-reported pain levels.

A significant three-way interaction ($F_{3, 195} = 4.60$, $P < 0.001$) was noted for the "worst pain" subscale of the BPI. Results of follow-up tests showed that participants in the Website group recruited online reported a significantly greater mean decrease in self-reported "worst pain" from baseline to posttest (t = 2.71, $P < 0.05$), while no significant differences between conditions over time were noted for the participants recruited from the pain clinic. In addition, a significant three-way interaction was noted for the "average pain" subscale of the BPI, $F_{3, 195} = 3.20$, $P < 0.05$, suggesting a differential response to the intervention between participants recruited online compared with those recruited through pain clinics. Participants in the Website group recruited online reported a decrease in average pain from baseline to the 3-month follow-up assessment (t = 2.52, $P < 0.05$), whereas no significant differences were seen in participants recruited from the pain clinic (Tables 3 and 4).

When comparing study results to the IMMPACT criteria, we observed a 12.3% decrease in current pain from baseline to post-intervention among Website participants, as compared with a 7% decrease in controls (Table 5).

Increased Physical Functioning

The effect of the Website intervention compared with the control condition over time on participants' self-reported physical functioning was tested; no statistically significant effect of condition over time on physical functioning was noted.

PGIC

A LMM was run to test for a significant effect of treatment on participants' global impression of change. Significant effects of both treatment ($F_{1, 181} = 13.49$, $P < 0.01$) and time ($F_{2, 18} = 12.39$, $P < 0.01$) were noted; compared with the control group, Website participants reported a greater average improvement in their condition at posttest (t = 3.01, $P < 0.01$), 3-month follow-up (t = 2.71, $P < 0.05$), and 6-month follow-up (t = 2.83, $P < 0.05$) (Table 2). Examination of the distribution of participants across categories of perceived improvement revealed that a greater proportion of Website participants (56.6%, compared with 33.0% of controls, immediately post-intervention) reported at least a minimal improvement in their condition as a result of the study. Participants who used the Website did not report clinically significant changes in physical functioning (see Table 5).

Discussion

This study offers evidence that painACTION-Back Pain, an online self-management program for persons with chronic back pain, is helpful in reducing pain and stress, and improving coping abilities. Comparisons with the IMMPACT criteria [26] indicated differences between the Website and control groups in ratings of current pain

intensity, depression, anxiety, stress and global ratings of improvement that may be *clinically* significant. In addition, this study revealed that, in terms of pain reduction and coping, participants recruited online responded better to the Website intervention than those recruited through a pain clinic. Hypotheses that exposure to painACTION-Back Pain would significantly reduce pain, increase physical functioning, reduce psychological distress, and increase self-efficacy to perform pain self-management activities in comparison to the control group were not supported.

Perceptions of stress, active coping, and social support changed as a result of exposure to painACTION-Back Pain. Increases in using coping self-statements changed in the Website group compared with the control group and were present at both the 3-month and 6-month follow-up period. This finding is consistent with associations between coping and chronic pain in non-Web delivered interventions (e.g., Lopez-Martinez et al. and Jensen et al. [43,44]). In a Web-based intervention, Buhrman et al. [19] found changes in catastrophizing, perceptions of control over pain, and the ability to decrease pain, but not specifically in increasing coping self-statements. Increases in the use of social support were also found from baseline to 6-month follow-up for the intervention group, but not the control group. We are unaware of other similar findings in studies utilizing Internet-delivered self-management programs for back pain. The mechanism of this finding should be explored in future studies. In our study, social support was measured as a form of coping. Although increases in social support as a form of coping with pain might be expected following a support group intervention, an Internet-delivered self-management program would not ordinarily be expected to affect this dimension of coping. Perhaps increases in active coping strategies (i.e., coping self-statements) and decreases in perceived stress over time affected the willingness of intervention participants to seek social support from significant others.

Reductions in pain were not found between the Website and control conditions, which is not an unusual finding in the literature on CBT and pain, and other studies of Internet-delivered self-management interventions. In randomized controlled trials of CBT and behavior therapy for people with pain conditions, mixed results on pain reduction are found [45]. In most trials, pain was not a primary outcome, precisely because pain was not expected to change due to the interventions employed, and more emphases were placed on coping with pain [45]. These mixed results are similar to other Internet-delivered interventions. Compared with individuals in control conditions, changes in pain were found from baseline to posttest for an e-mail intervention for back pain [20] and a 5-month Internet-delivered self-management program for back pain [21], but not for a 6-week CBT Internet-based treatment with telephone follow-up [19]. Although changes in pain were not statistically different between conditions over time, the IMMPACT criteria for a clinically significant difference were found over time for participants in the Website condition.

There may have been several reasons for the lack of findings in other areas (e.g., physical functioning, psychological distress, self-efficacy). The interventions as designed were tailored to the person based on personal characteristics and were not chosen to be correlated with each measure. Basic self-management themes were addressed across multiple content items, e.g., communication with providers, medication safety, emotional coping, etc. The participant was instructed to complete the tailored content and then allowed to explore the rest of the site (i.e., a "library" of back pain content). This approach attempted to balance recommended exposure to personally meaningful content with the self-selected way in which Websites are typically used ("surfing"). However, this did not guarantee that all areas relevant to the outcome measures would be covered. It is possible that a different approach to assessment may be needed to capture differences in groups exposed to tailored rather than fixed content.

In addition to examining the differences between the Website condition and the control condition over time among all participants, we tested whether the Website, as compared with the control condition, was particularly effective for certain subgroups. Recruitment source, age, and baseline pain level were found to be moderators of the effect of the Website intervention over time. Recruitment source proved to be a robust moderator variable, with results favoring those who were recruited through other means (online, ads, etc.) vs a pain clinic. Among participants recruited online, those exposed to the Website reported significantly: 1) lower "worst" pain; 2) lower "average" pain; and 3) increased coping self-statements, compared with controls, whereas participants recruited through the pain clinic evidenced no such differences. Available data suggest that pain clinic patients are more complex than community pain patients, evidencing greater functional and psychosocial impairments [46]. Indeed, 58.6% of the clinic sample in this study was persons with disabilities, while the disability rate among participants recruited through other means was 21.4%. It is possible that individuals who seek help at pain management clinics have reached a stage of severity that reduces the potential of further treatment gains. Another possibility is that patients in a multidisciplinary clinic have already received at least some information similar to that presented on painACTION-Back Pain (even though the information may not have been tailored), suggesting a ceiling effect. Finally, the group recruited online may have been more comfortable and/or adept at using the Website intervention.

Several limitations in this study should be noted. Website participants were more likely to have more intensive intervention exposure and monitoring over time than control participants. The closer monitoring of the Website group may explain why a larger number of Website participants than control participants were removed from the study sample. Although the proportions were significantly different, each proportion made up a small subset of the respective groups. The

investigators do not feel that this constitutes a major threat to study validity.

There were also differences in the manner in which the interventions were delivered. Individuals in the control condition were asked to read a text-based guide during the course of the 1-month intervention period. The information was not given sequentially, controlling for the incremental nature in which the Website group received information. While this design led to somewhat less experimental control, we believe the results to be more generalizable. Individuals in both conditions received exposure to the materials that would have been typical for that group (i.e., a health care professional would likely not dictate how much of a guide to read at a time). However, there was a possible differential influence in staff contact due to reminders to the Website group to complete protocols that was not tested in this study. Much more needs to be understood regarding dosage differences in Web-based research and their relation to outcome [27]. For example, some participants benefit from brief exposure to Web-based interventions and may drop out earlier than others, yet benefit from the brief exposure, while others may need to be exposed and engaged to benefit [28]. Methodological differences and best practices for research on Web-based interventions are only beginning to be discussed in the literature (e.g., Danaher and Seeley, and Ritterband et al. [27,47]).

There were differences in the samples recruited when compared by recruitment source. It is possible that the source of recruitment may be a proxy for other variables (e.g., demographics, severity, disability, socioeconomic status). Although some of the differences observed in the study were probably due to the nature of the sample populations (e.g., online vs a specialized pain clinic population) and would not change in subsequent studies, the overall sample might change with additional recruitment of patients with pain from other treatment settings (primary care, community health clinics, etc.). In addition, the recruitment sources utilized in this study resulted in a sample that was primarily Caucasian, and samples with greater minority participation may result in different outcomes.

Conclusions

This study confirms that an online self-management program with tailored content for persons with chronic back pain can effect changes in stress, coping, and social support, and produce *clinically* significant differences in pain, depression, anxiety, and global rates of improvement. Website interventions may be more effective in specific demographic or functional subgroups, such as patients with higher levels of pain, older participants, and participants whose condition has not yet reached a level of severity that would lead them to seek specialized care at a pain clinic. Further research is needed to determine which clinical groups may be most effectively treated by an online intervention, as well as to determine the mechanisms of change, and to better understand why some dimensions changed after exposure to the treatment while others did not.

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References

1 Dillon C, Paulose-Ram R, Hirsch R, Gu O. Skeletal muscle relaxant use in the United States: Data from the Third National Health and Nutrition Examination Survey (NHANES III). Spine 2004;29:892–6.

2 Proctor, T, Gatchel, RJ, Robinson, RC. Psychosocial factors and risk of pain and disability. Occup Med 2000;15(4):803–12.

3 Jensen MP, Nielson WR, Kerns RD. Toward the development of a motivational model of pain self-management. J Pain 2003;4(9):477–92.

4 Bodenheimer T, Lorig K, Holman H, Grumbach K. Patient self-management of chronic disease in primary care. JAMA 2002;288(19):2469–75.

5 Lorig KR, Ritter P, Stewart A, et al. Chronic disease self-management program: 2-year health status and health care utilization outcomes. Med Care 2001; 39(11):1217–23.

6 Jensen MP, Romano JM, Turner JA, Good AB, Wald LH. Patient beliefs predict patient functioning: Further support for a cognitive-behavioural model of chronic pain. Pain 1999;81(1–2):95–104.

7 Jensen MP, Turner JA, Romano JM. Changes in beliefs, catastrophizing, and coping are associated with improvement in multidisciplinary pain treatment. J Consult Clin Psychol 2001;69(4):655–62.

8 Moore JE, Von Korff M, Cherkin D, Saunders K, Lorig K. A randomized trial of a cognitive-behavioral

program for enhancing back pain self care in a primary care setting. Pain 2000;88(2):145–53.

9 MacGregor AD, Hayward L, Peck DF, Wilkes P. Empirically grounded clinical interventions clients' and referrers' perceptions of computer-guided CBT (FearFighter). Behav Cogn Psychother 2009;37:1–9.

10 Science Panel on Interactive Communication and Health. Wired for Health and Well-Being: The Emergence of Interactive Health Communication. Washington DC: U.S. Department of Health and Human Services, U.S. Government Printing Office; 1999.

11 Williams ML, Freeman RC, Bowen AM, et al. A comparison of the reliability of self-reported drug use and sexual behaviors using computer-assisted versus face-to-face interviewing. AIDS Educ Prev 2000; 12(3):199–213.

12 Pelise F, Sell P, EuroSpine Patient Line Task Force. Patient information and education with modern media: The Spine Society of Europe Patient Line. Eur Spine J 2009;18(suppl 3):395–401.

13 Fox S, Fallows D. Internet health resources: Health searches and email have become more commonplace, but there is room for improvement in searches and overall Internet access. Pew Internet and American Life Project, 2003. Available at: http://www.pewinternet.org/~/media//Files/Reports/2003/PIP_Health_Report_July_2003.pdf.pdf (accessed January 2010).

14 Berland GK, Elliott MN, Morales LS, et al. Health information on the Internet: Accessibility, quality, and readability in English and Spanish. JAMA 2001;285(20): 2612–21.

15 Washington TA, Fanciullo GJ, Sorensen JA, Baird JC. Quality of chronic pain websites. Pain Med 2008;9: 994–1000.

16 Butler L, Foster NE. Back pain online: A cross-sectional survey of the quality of web-based information on low back pain. Spine 2003;28(4):395–401.

17 Li L, Irvin E, Guzmán J, Bombardier C. Surfing for back pain patients: The nature and quality of back pain information on the Internet. Spine 2001;26(5):545–57.

18 Corcoran TB, Haigh F, Seabrook A, Schug SA. The quality of internet-sourced information for patients with chronic pain is poor. Clin J Pain 2009;25(7):617–23.

19 Buhrman M, Faitenhag S, Strom L, Andersson G. Controlled trial of Internet-based treatment with telephone support for chronic back pain. Pain 2004;11: 368–77.

20 Lorig KR, Laurent DD, Deyo RA, et al. Can a back pain e-mail discussion group improve health status and lower health care costs?: A randomized study. Arch Intern Med 2002;162(7):792–6.

21 Schulz PJ, Rubiniell S, Hartung U. An internet-based approach to enhance self-management of chronic low back pain in the Italian-speaking population of Switzerland: Results from a pilot study. Int J Public Health 2007;52:286–94.

22 Barak A, Klein B, Proudfoot JG. Defining Internet-supported therapeutic interventions. Ann Behav Med 2009;38(1):4–17.

23 Chiauzzi E, Zacharoff K, Venuti SW, Pant P. painACTION.com: An interactive self-management website for chronic pain patients. Poster presented at PainWeek, the annual conference of the American Society of Pain Educators, Las Vegas, NV; 2009.

24 Dworkin RH, Turk DC, Wyrwich KW, et al. Interpreting the clinical importance of treatment outcomes in chronic pain clinical trials: IMMPACT recommendations. J Pain 2008;9(2):105–21.

25 Wei LJ. On the random allocation design for the control of selection bias in sequential experiments. Biometrika 1978;65:79–84.

26 National Institute of Neurological Disorders and Stroke (U.S.). Low Back Pain Fact Sheet. Bethesda, MD: Office of Communications and Public Liaison National Institute of Neurological Disorders and Stroke; 2003.

27 Danaher BG, Seeley JR. Methodological issues in research on web-based behavioral interventions. Ann Behav Med 2009;38(1):28–39.

28 Cleeland CS, Ryan KM. Pain assessment: Global use of the Brief Pain Inventory. Ann Acad Med Singapore 1994;23(2):129–38.

29 Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry Low Back Pain Disability Questionnaire. Physiotherapy 1980;66:271–3.

30 Fisher K, Johnston M. Validation of the Oswestry Low Back Pain Disability Questionnaire: It's sensitivity as a measure of change following treatment and its relationship with other aspects of the chronic pain experience. Physiother Ther Pract 1997;13:67–80.

31 Fritz JM, Irrgang JJ. A comparison of a modified Oswestry Low Back Pain Disability Questionnaire and the Quebec Back Pain Disability Scale. Phys Ther 2001;81(2):776–88.

32 Lovibond SH, Lovibond PF. Manual for the Depression Anxiety Stress Scales, 2nd edition. Sydney: Psychology Foundation; 1995.

33 Guy W. ECDEU Assessment Manual for Psychopharmacology. DHEW Publication No. ADM 76-338. Washington, DC: US Government Printing Office; 1976.

34 Dunkl PR, Taylor AG, McConnell GG, Alfano AP, Conaway MR. Responsiveness of fibromyalgia clinical trial outcome measures. J Rheumatol 2000;27:2683–91.

35 Farrar JT, Young JP Jr, LaMoreaux L, Werth JL, Poole RM. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. Pain 2001;94:149–58.

36 Jensen MP, Turner JA, Romano JM, Strom SE. The chronic pain coping inventory: Development and preliminary validation. Pain 1995;60(2):203–16.

37 Romano JM, Jensen MP, Turner JA. The chronic pain coping inventory-42: Reliability and validity. Pain 2003;104(1–2):65–73.

38 Sullivan MJ, Bishop SR, Pivik J. The Pain Catastrophizing Scale: Development and validation. Psychol Assess 1995;7(4):524–32.

39 Nicholas MK. Self-efficacy and chronic pain. Paper Presented at the Annual Conference of the British Psychological Society, St. Andrews, UK; 1989.

40 Nicholas MK. The pain self-efficacy questionnaire: Taking pain into account. Eur J Pain 2007;11:153–63.

41 Waddell G, Newton M, Henderson I, Somerville D, Main CJ. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain 1993;52(2):157–68.

42 Moher D, Schulz KF, Altman D. The CONSORT statement: Revised recommendations for improving the quality of reports of parallel-group randomized trials. JAMA 2001;285(15):1987–91.

43 Lopez-Martinez AE, Esteve-Zarazaga E, Ramirez-Maestre R. Perceived social support and coping responses are independent variables explaining pain adjustment among chronic pain patients. J Pain 2008;9:373–9.

44 Jensen M, Turner J, Romano J. Changes after multidisciplinary pain treatment in patient pain beliefs and coping are associated with concurrent changes in patient functioning. Pain 2007;131:38–47.

45 Eccleston C, Williams AC, Morley S. Psychological therapies for the management of chronic pain (excluding headache) in adults. Cochrane Database Syst Rev 2009;15(2):CD007407.

46 Mailis-Gagnon A, Yegneswaran B, Lakha SF, et al. Pain characteristics and demographics of patients attending a university-affiliated pain clinic in Toronto, Ontario. Pain Res Manag 2007;12(2):93–9.

47 Ritterband LM, Thorndike FP, Cox DJ, Kovatchev BP, Gonder-Frederick LA. A behavior change model for internet interventions. Ann Behav Med 2009;38(1):18–27.