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Happy Despite Pain

A Randomized Controlled Trial of an 8-Week Internet-delivered Positive Psychology Intervention for Enhancing Well-being in Patients With Chronic Pain

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Objectives: There is preliminary evidence for the efficacy of positive psychology interventions for pain management. The current study examined the effects of an internet-based positive psychology self-help program for patients with chronic musculoskeletal pain and compared it with an internet-based cognitive-behavioral program.

Materials and Methods: A randomized controlled trial was carried out with 3 conditions: an internet-delivered positive psychology program, an internet-delivered cognitive-behavioral program and waitlist control. A total of 276 patients were randomized to 1 of the 3 conditions and posttreatment data were obtained from 206 patients. Primary outcomes were happiness, depression, and physical impairments at posttreatment and at 6-month follow-up. Intention-to-treat analyses were carried out using mixed regression analyses.

Results: Both treatments led to significant increases in happiness and decreases in depression. Physical impairments did not significantly decrease compared with waitlist. Improvements in happiness and depression were maintained until 6-month follow-up. There were no overall differences in the efficacy of the 2 active interventions but effects seemed to be moderated by education. Patients with a higher level of education profited slightly more from the positive psychology intervention than from the cognitive-behavioral program.

Discussion: The results suggest that an internet-based positive psychology and cognitive-behavioral self-help interventions for the management of chronic pain are clinically useful. Because the self-help exercises as used in the current program do not require therapist involvement, dissemination potential is large. Further studies should examine whether it can best be used as stand-alone or add-on treatment combined with established pain treatment programs.

Key Words: positive psychology intervention, cognitive-behavior therapy, internet-based treatment, randomized controlled trial, chronic pain

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Chronic pain is a substantial health care problem, leading to high socioeconomic and personal costs.[1] In addition to physical disabilities, chronic pain is associated with high levels of emotional distress. Around half of chronic pain patients meet criteria for depression and even more experience depressed mood at a subclinical level.[2–4] Teaching patients adaptive ways to cope with the debilitating effects of their condition is essential for successful pain management. Recently the adoption of positive psychology techniques in pain management programs for individuals with chronic pain has been advocated.[5–7] Some current interventions for patients with chronic pain have already incorporated such a positive focus, for example, mindfulness-based techniques,[8] Acceptance and Commitment Therapy,[9] and Loving Kindness Meditation.[10] However, there is so far only limited evidence for the usefulness of positive psychology self-help techniques in chronic pain management.

Positive psychology self-help exercises have been shown to increase well-being and decrease depressive symptoms in nonclinical populations as well as in patients with mild to moderate depressive symptoms.[11,12] Preliminary evidence suggests that chronic pain patients might equally benefit from such a positive psychology self-help approach. Hausmann et al[13] performed a secondary analysis of data from a previous randomized controlled trial (RCT) on the efficacy of positive psychology exercises offered through the internet to decrease depressive symptoms in self-help seeking individuals. For this secondary analysis they selected a subgroup of participants reporting mild to moderate pain at baseline. The positive psychology self-help exercises led to significant reductions in pain intensity 6 months after the intervention. More direct

evidence for the usefulness of positive psychology exercises for chronic pain management was reported by Müller et al.[14] These researchers examined the feasibility and efficacy of an internet-based positive psychology intervention (PPI) for people experiencing chronic pain secondary to physical disability. Feasibility and preliminary efficacy of the intervention was demonstrated by significant pretreatment to posttreatment improvements in pain intensity, pain control, pain interference, life satisfaction, and depression that were maintained up to 2.5 months after the intervention.

The present study sought to carry out the first large-scale RCT examining the efficacy of an internet-based positive psychology self-help intervention for patients with chronic pain. An 8-week internet-based program called "Happy Despite Pain" was developed, which consisted of 4 empirically validated positive psychology exercises. These exercises aimed at bolstering positive behaviors, emotions, and cognitions that have been found to be associated with better chronic pain adjustment, namely self-compassion, positive affect, and optimism. Self-compassion means responding to ones difficulties with kindness and compassion rather than self-criticism.[15] Teaching patients to approach their experience in a self-compassionate way is suggested to promote resilient coping.[16] Indeed, correlational studies have reported that chronic pain patients scoring higher on self-compassion are less disabled, have better mood, and catastrophize less about their pain.[17] The second target component, positive affect, is also associated with increased adaptation to the challenges of chronic pain; frequent and sustained experiences of positive emotions predict adaptive recovery from pain and improve overall functioning.[7] Finally, optimism seems to be one of the most important positive cognitions promoting adaptive coping with pain and counteracting pain catastrophizing.[18–20] Although optimism is often seen as a trait characteristic, recently it was shown that optimism can be enhanced by positive imagery techniques[21] and that this has implications for coping with pain.[22,23]

The purpose of the present study was to examine the efficacy of the "Happy Despite Pain" intervention to increase happiness and decrease depression and physical impairments in patients experiencing chronic musculoskeletal pain. Because it is desirable to compare the effects of new interventions with those of established ones, we set up a 3-armed trial in which we compared the new PPI with an internet-based cognitive-behavioral therapy (iCBT) intervention for chronic pain and a waitlist control condition. CBT is regarded as the golden standard for pain management[24] and recent systematic reviews suggested that iCBT can be as effective as face-to-face CBT for the management of chronic pain.[25,26] The iCBT intervention used in the current trail was shown to have beneficial effects for patients with chronic pain in 2 successive trials.[27,28] We expected that both PPI and iCBT would lead to significant improvements in happiness, depression, and physical impairments compared with being on the waitlist. In addition, we examined sex and educational level as potential effect moderators.

MATERIALS AND METHODS

Participants

Recruitment took place from April 2012 until August 2012 through advertisements in national and local newspapers and magazines and through an announcement on the websites of the Dutch and Belgian Societies for Fibromyalgia patients. Individuals with fibromyalgia could apply by e-mail or through a link on a dedicated website. In total, > 400 people showed an interest in the study and received further information, and 350 of these completed the application form. All applicants were contacted by phone for a screening interview. The interview covered details of the pain complaints, the diagnosis, and the inclusion and exclusion criteria. Inclusion criteria were: age above 18 years, having musculoskeletal pain for longer than 3 months, either generalized pain (ie, fibromyalgia) or localized in back, neck or shoulders, good command of Dutch, and having access to the internet. Exclusion criteria were: not being able to perform simple physical exercises, having a degenerative muscle diseases or a condition that could aggravate due to physical activity (eg, spinal stenosis), heart or vascular diseases, being diagnosed with psychiatric disorders in the past 3 months, pregnancy and having had psychological or multidisciplinary pain treatment in the past 3 months. Of the 350 applicants, 49 were excluded: 16 because they could not be reached and 33 because they did not fulfill inclusion criteria. The remaining 301 participants received an information letter together with the informed consent form and a questionnaire covering demographic information and pain history. Of the 301 eligible participants, 284 returned their informed consent and were subsequently randomized into either one of the treatments or waitlist condition (WLC).

Randomization was performed with a 2:2:1 ratio with an overrepresentation of participants in the 2 treatment conditions, and a set upper limit of 50 participants in the control condition. The reason for this unbalanced allocation was to increase power to detect potential differences in efficacy between the 2 treatments and to allow for moderator analyses (ie, which treatment works best for whom).[29,30] To guarantee an equal distribution of sexes over the 3 conditions, male and female participants were randomized separately. Eight patients did not fill out the pretreatment measures, leaving a total of 276 participants in the study: 112 in the iCBT, 114 in the PPI, and 50 in the waiting list condition. In total, 70 participants (25.4%) dropped out in various weeks of the intervention period, resulting in 206 participants with completed posttreatment measures (80 in iCBT, 85 in PPI, and 41 in WLC). Follow-up assessment 6 months after completion of the program was only performed in patients participating in 1 of the 2 active treatments. We obtained data from 55 participants in the iCBT and 43 participants in the PPI condition, being 49% and 38% of the original sample, respectively. The flow of participants is shown in Figure 1.

Procedure

The study took place between July 2012 and August 2013. Both treatment programs were delivered through the internet. Participants could access the site where the program was hosted through a username and password and a 6-digit security code that was provided to their mobile phone at every login. A short instruction movie on how to get started with the program was shown at the first login. Only after filling out the online pretreatment assessment, the actual treatment program became available. Both treatments consisted of 8 modules. In the first week, only the first module could be accessed. Exactly 1 week later, module 2 became available, again 1 week later module 3,
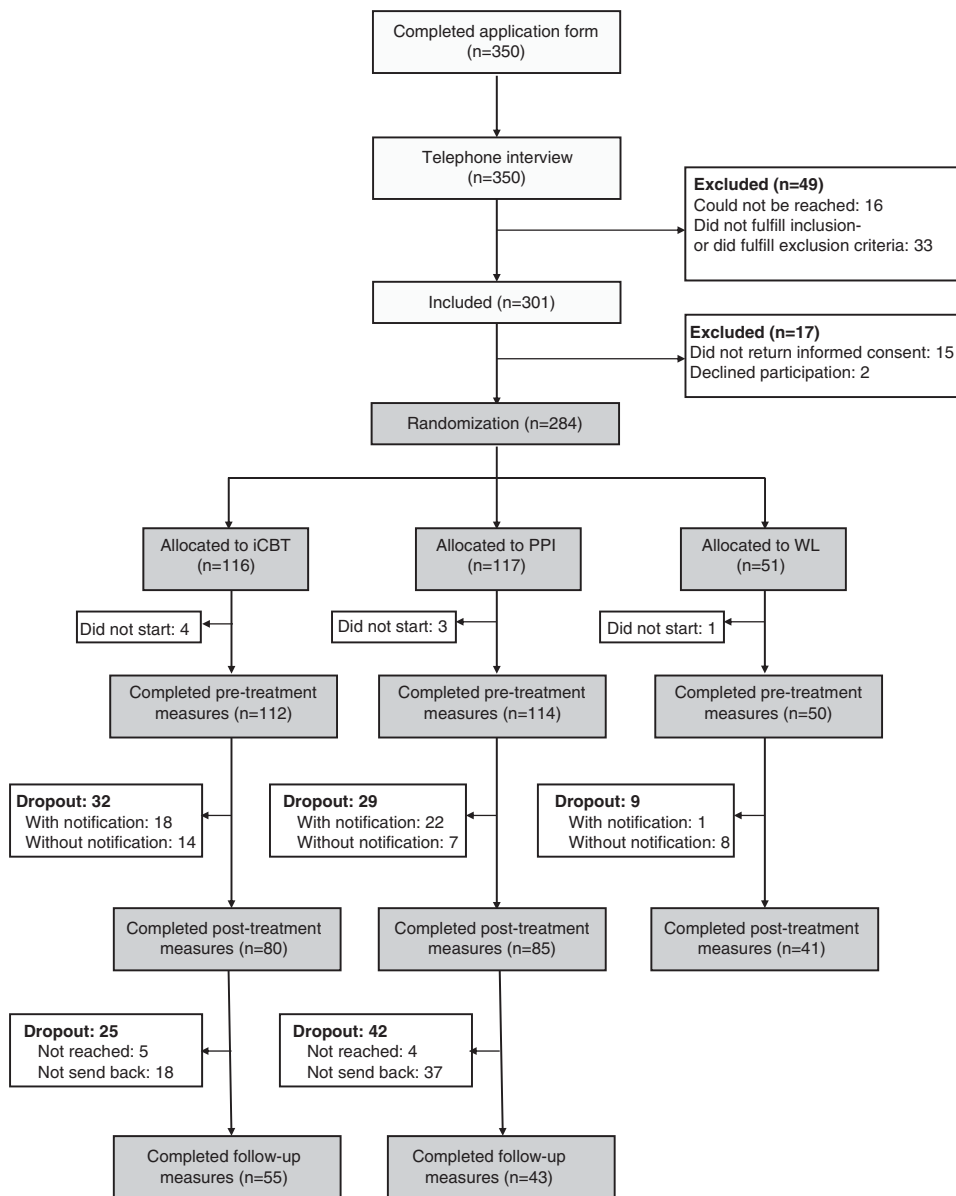
FIGURE 1. Flow of participants in the study. iCBT indicates internet cognitive-behavioral intervention; PPI, internet positive psychology intervention; WL, waitlist.

etc. Seven weeks after participants had started with the first module, the complete treatment program was available to them. Mean duration of the intervention for intervention completers was 9.3 weeks (range, 7 to 16 wk), with no difference between the 2 interventions.

Both treatments had the same format, with each module providing online written information about the topic of that week and practical assignments. Assignments could either be completed online or in a workbook that was provided to participants at the start of the intervention. This workbook contained a summary of the online information and all of the assignments, allowing patients to complete these without the need to login. However, participants were explicitly told that the paper workbook was not a replacement for the internet program because the extended information was provided online only.

To promote adherence, telephone (weeks 1, 3, 5, and 7) and e-mail (weeks 2, 4, 6, and 8) support was provided by 5 graduate or recently graduated students in Psychology. Every participant had a single assistant assigned to them. All assistants guided participants in the iCBT as well as the PPI condition. The telephone calls were semistructured and covered participants' efforts on the assignments of the previous weeks, possible problems, or questions regarding the modules. The average duration of the telephone calls was 15 to 20 minutes. Semistandardized e-mails were sent to participants in the weeks between the telephone contacts encouraging them to continue with the program and to share any problems they might have encountered. After participants had completed the program they were contacted one more time to thank them for their participation and to check whether they had completed their posttreatment measures or

remind them to do so if they had not. Participant in the iCBT and PPI condition were contacted 6 months after completion of the program by e-mail or telephone and requested to fill in the long-term follow-up assessment.

In the WLC participants were initially only given access to the online pretreatment questionnaires. After an 8-week waiting period, participants were contacted and asked to complete the postmeasurements. After completion, they could start with the treatment program of their choice (iCBT or PPI). No further data were obtained from these patients after completion of the program and no support was provided during the intervention period, except for assistance in case of technical problems.

Treatment Programs

The iCBT Intervention

The iCBT treatment program was based on the program developed and previously tested in Sweden.[27] The usefulness of this program for patients with chronic pain has been established in previous research.[27,28] The main purpose of the program was to teach participants more active ways of coping with their pain and to improve their level of functioning. The original Swedish texts were translated in Dutch and slightly adapted to Dutch culture. The program consisted of 7 modules teaching applied relaxation, stretching exercises, cognitive restructuring, and coping techniques. In module 2, 3, and 4 bodyscan exercises were provided, in text and in mp3 format, and could be downloaded. In the eighth module participants made a relapse prevention plan, that is, how to continue with the strategies they had learned. The weekly components of the iCBT program are presented in Table 1. More information on the various components and structure of the program can be found in Buhrman et al.[27]

Happy Despite Pain: An Internet PPI

The main purpose of the PPI intervention was to promote positive behaviors, emotions, and cognitions. The content of the internet PPI program was based on a literature review of evidence-based positive psychology exercises and specifically targeted self-compassion, positive emotions, and optimism. The intervention had a gradual build-up, starting with simple exercises, and gradually working toward more complex and cognitively effortful exercises. The program started with self-compassion exercises (week, 1 to 2) to teach participants to become more self-reliant when dealing with the emotional consequences of their condition. Exercises in these first 2 modules involved becoming aware of one's suffering and self-criticism, keeping a self-compassion diary, using a self-compassion mantra and writing a self-compassion letter to oneself.[31] During the next week, the "Three Good Things" exercise was practiced with the aim to raise awareness for the good things in life and to shift the focus from a negative orientation toward a more positive one. This is one of the most frequently used and best tested exercises within positive psychology and consists of writing down 3 good things that went well that day, and why they went well.[12] During the next 2 weeks participants were taught savoring techniques, with the aim to increase the frequency and intensity of positive experiences in daily life. These modules involved several exercises: being aware of small daily pleasures, planning pleasant activities, engaging in pleasant reminiscence, and keeping a savoring diary.[32]

TABLE 1. Overview of the Modules for the iCBT and PPI Intervention

Weeks	Content iCBT Modules	Content PPI Modules
0	Pretreatment assessment	Pretreatment assessment
	Sending of workbook	Sending of workbook
1	Pain education	Self-compassion
	Applied relaxation: diaphragmatic breathing	Awareness of suffering
	Identification of risk situations	Self-compassion diary
2	Applied relaxation: bodyscan	Self-compassion
	Stretching exercises	Self-compassion mantra
		Self-compassion letter
		Self-compassion diary
3	Applied relaxation: bodyscan	Positive focus
	Cognitive restructuring	Three good things exercise
	Activity planning	
	Coping	
4	Applied relaxation: bodyscan	Savoring
	Stress management	Planning of pleasant activities
	Activity planning	Recall of pleasant memories
	Coping	Savoring diary
5	Sleep education	Savoring
	Applied relaxation: mindfulness	Enjoying daily activities
	Activity planning	Planning of pleasant activities
	Coping	Recall of pleasant memories
		Savoring diary
6	Assertiveness training: saying no	Optimism
	Activity planning	Formulation of Best Possible Self
	Coping	Best Possible Self visualization
7	Problem-solving techniques	Optimism
	Activity planning	Formulation of Best Possible Self
	Coping	Best Possible Self visualization
8	Formulation of maintenance program	Formulation of maintenance program
9	Posttreatment assessment	Posttreatment assessment

iCBT indicates internet-based cognitive-behavioral therapy; PPI, positive psychology intervention.

Week 6 and 7 were devoted to increasing optimism for the future by means of writing about and imagining the "Best Possible Self".[21] The Best Possible Self exercise was adapted to patients with pain in that they were instructed to imagine a good life in the future despite their pain. Patients selected 3 domains for their visualization in week 6 from a list of 7 life domains (family life, romantic life, social life, professional life, leisure and hobby, educational life, societal commitment, and personal growth) and formulated future goals and ideals for each of these domains. Next, they wrote a more detailed narrative of how their ideal future in these domains would look like. Each day they visualized this future in 1 of the 3 domains. In week 7 patients choose 3 new life domains and continued the exercise with these new domains. In week 8 participants made a plan for the future, what exercises they wanted to continue using, and when and how. The aim was to prevent relapse. The weekly components of the PPI program are presented in Table 1.

A slightly different (face-to-face) version of the intervention was piloted in 6 patients with chronic pain, after which it was adapted and again piloted in 5 additional patients with chronic pain. The program was found feasible and potentially useful.[33]

Measures

All pretreatment and postintervention and follow-up questionnaires were delivered via the internet. At all 3 timepoints the same set of questionnaires were provided. We assessed different indices of mental and physical well-being, namely happiness, depression, anxiety, physical impairments, and pain intensity. In addition, variables that were targeted by one or both of the interventions were assessed: self-compassion, positive and negative affect, optimism, flexible goal adjustment (FGA), pain catastrophizing, perseverative thinking, helplessness, acceptance, and disease benefits. Because of the large number of dependent variables being examined we defined 3 primary outcomes, happiness and depression as indicators of respectively positive and negative mental well-being and physical impairments as indicator of physical well-being. All other dependent variables were considered secondary outcomes.

Primary Outcomes

Depression was measured with the Hospital Anxiety and Depression Scale (HADS[34]). The HADS consists of 14 items, 7 of which assess depressive symptoms, the other 7 assess anxiety symptoms. Items are rated on a 4-point scale ranging from 0 to 3. The total depression score is obtained by summing the scores of the 7 relevant items and ranges from 0 to 21. Cronbach α in the present study was 0.79 at pretest and 0.80 for the post and follow-up assessments. Happiness was measured with 1 item, and assessed the feelings of happiness/unhappiness at the present moment. A 6-point scale was used with the following verbal labels: 1, very unhappy; 2, unhappy; 3, more unhappy then happy; 4, more happy then unhappy; 5, happy; 6, very happy. Measuring happiness by single-item questions has been found reliable and valid.[35] Physical impairments were assessed by means of the Fibromyalgia Impact Questionnaire (FIQ).[36] The FIQ has 11 physical impairment items which inquire about the ability to independently perform daily physical activities (eg, vacuum cleaning, preparing meals, visiting family). Each item is rated from 0 (always) to 3 (never). Nine of these items were used to assess physical impairment in the present study. Two items inquiring about the ability to drive a car and to work in the garden were excluded from the total score because these items were not relevant for all participants. The sum score of the 9 items was calculated, thus ranging from 0 to 27. Cronbach α in the present study was 0.87 at pretest and 0.88 for the post and follow-up assessments.

Secondary Outcomes

Anxiety was measured with the 7 anxiety items of the HADS (see above). Scores can range from 0 to 21. Cronbach αs in the present sample ranged from 0.83 to 0.85. Pain intensity was measured by the item "At this moment, how much pain do you experience," scored from 0 to 10. Self-compassion was measured with the 12-item short form of the Self-Compassion Scale (SCS-SF).[37] The SCS-SF measures the 3 main components of self-compassion: self-kindness, common humanity, and mindfulness. Responses

are given on a 7- point scale ranging from 1 (almost never) to 7 (almost always) and a total score was calculated (range, 7 to 84; Cronbach αs, 0.88 to 0.89). Positive and negative mood were assessed with the Brief Mood Introspection Scale (BMIS).[38] The BMIS consists of 8 positive and 8 negative mood descriptors that are rated on a 10-point scale. Cronbach αs range from 0.84 to 0.88 for both subscales. Optimism was measured by the Life Orientation Test-revised (LOT-R).[39] The LOT-R consists of 10 items; 3 positively phrased, 3 negatively phrased, and 4 filler items. All items are rated on a 5-point scale, ranging from 1 to 5. A total optimism score is calculated by summing the scores of the 3 positive phrased items plus the reversed scores of the 3 negative phrased items (range, 6 to 30; Cronbach αs, 0.76 to 0.87).

FGA was measured using the scale developed by Brandtstädter and Renner.[40] The FGA scale consists of 15 items measuring the tendency to flexibly select new goals when the original goal becomes blocked. Items are scored from 0 (= not agree at all) to 4 (= totally agree). Cronbach αs ranged from 0.82 to 0.85. Pain catastrophizing was measured with the Pain Catastrophizing Scale (PCS).[41] The PCS consists of 13 items reflecting catastrophic thoughts about pain. Items are rated on a 5-point scale ranging from 0 to 4. The total PCS score is obtained by summing the scores of all items, and can range from 0 to 52 (Cronbach αs, 0.92 to 0.93). The Perseverative Thinking Questionnaire (PTQ[42]) was used to assess repetitive thinking. The PTQ consists of 15 statements assessing ruminative and intrusive thoughts that are scored on a 5-point scale (0, never; 4, almost always). Cronbach α was 0.96 at all 3 assessment times. The Illness Coping Questionnaire (ICQ[43]) was used to measure helplessness, acceptance, and disease benefits. The ICQ consists of 18 items that are scored on a 4-point scale (1 to 4). Six items assess helplessness, 6 acceptance, and 6 disease benefits. Item scores per subscale are summed to obtain scores for the 3 different coping styles (range, 6 to 24). Cronbach αs ranged from 0.82 to 0.88 for helplessness,0.87 to 0.91 for acceptance, and 0.85 to 0.88 for disease benefits.

Statistical Analyses

Statistical analyses were performed with SPSS version 24. Intention-to-treat analyses were performed by means of mixed linear regression analysis per outcome variable, which includes all patients who started with the intervention, and which does not require imputation of missing data. Condition (iCBT, PPI, WLC) was the between-subject factor, and time of measurement the within-subject factor. The effect of interest was the condition by time interaction. We assumed an unstructured covariance matrix for the repeated measures of the outcome variable at hand, which is the most general structure. As patients in the WLC condition did not provide 6-month follow-up data, the difference in the immediate posttreatment effects between all 3 conditions and the difference in long-term effects between the 2 active treatment conditions were tested in separate regression models. In the first set of regression models condition had 3 levels, iCBT versus PPI versus WLC (reference group), and time had 2 levels, baseline (reference timepoint) versus posttreatment. In the second set of regression models condition had 2 levels, iCBT versus PPI, and time had 3 levels, baseline versus posttreatment versus follow-up. In all models, adjustments for age, sex, and educational level were made. Two dummies were

created for education (medium vs. low; high vs. low). For each outcome, we checked normality and homogeneity of variance of the residuals as well as the absence of outliers or influential cases. An α of 0.05 was used to establish significance for the primary dependent variables, and 0.01 for the secondary variables. For all outcomes effect sizes together with their 95% confidence interval are reported. The effect size was computed as the regression weight of the condition by time interaction term divided by the residual outcome variance at that timepoint, for instance the regression weight of the iCBT dummy by posttest dummy interaction divided by the residual outcome variance at posttest. This measure can be interpreted as Cohen *d* corrected for the covariates in the model (Cima et al[44]).

In a further set of analyses, to establish whether the effects of the intervention (PPI vs. iCBT) were moderated by sex or educational level, the relevant interaction terms were added to the model. For testing moderation by sex the following terms were added: condition by sex, time by sex, and condition by time by sex (using dummy coding for condition, time, and sex). For testing moderation by education we added the following terms: condition by educational level, time by educational level, condition by time by educational level, again using dummy coding. Moderation is reflected by the 3-way interaction, which was tested with a likelihood ratio (LR) test of the model with, versus the model without, the 3-way interaction. Maximum Likelihood estimation was used to allow LR testing.[45] An α of 0.05 was used for the 3 primary outcomes, and an α of 0.01 for the secondary outcomes. If moderation was found, then the condition effect was tested per level of the moderator.

To assess the clinical relevance of the interventions we used the HADS. The authors of the HADS propose a cut-off score of 11 to define cases of anxiety/depression and scores of 8 to 10 as doubtful cases. Scores below 8 denote noncaseness.[34] The difference in the number of patients scoring 8 or higher (ie, indicating [doubtful] caseness) at postintervention and follow-up was tested by means of mixed logistic regression analysis with condition as between-subject factor, time of measurement as within-subject factor (reference: baseline), and age, sex, and educational level as covariates, using the same modeling procedure as for the continuous HADS score.

RESULTS

Participants

Patient characteristics and baseline data are displayed in Table 2. Mean age of patients was 48.6 years (SD = 12.0) and mean pain duration was 12.8 years (SD = 10.1). In total, 85% of the sample was female and two third suffered from fibromyalgia. There were no significant differences between the 3 conditions in patient characteristics except for education ($\chi^2 = 10.4$; $P = 0.035$) and sick leave ($\chi^2 = 6.4$; $P = 0.040$). Patients in the iCBT condition were less likely to have an educational level in the medium category compared with the other treatment groups, and reported less sick leave compared with WLC. Significant differences on the pretreatment assessment of primary and secondary outcome variables occurred for anxiety ($F_{2,274} = 3.22$, $P = 0.042$) and benefit finding ($F_{2,273} = 5.36$, $P = 0.005$). Post hoc testing indicated that for anxiety the difference was between iCBT and WLC, and for disease benefits between both iCBT and PPI versus WLC. These

TABLE 2. Characteristics of Participants in the 3 Treatment Groups

	WLC (n = 50)	PPI (n = 114)	iCBT (n = 112)
Men (n [%])	6 (12)	19 (17)	17 (15)
Education (high/medium/low)	7/24/19	11/53/50	20/32/59*
Age (mean [SD])	50.6 (10.1)	47.5 (13.2)	48.7 (11.5)
Range	26-74	19-83	20-75
Pain duration (mean [SD]) (y)	10.3 (7.6)	13.6 (11.6)	13.2 (9.3)
Sick leave (n [%])	14 (28)	21 (18)	12 (11)
Disability pension (n [%])	8 (16)	26 (23)	26 (23)
Fibromyalgia (n [%])	34 (68)	81 (71)	69 (61)

*One person did not report education level.
iCBT indicates internet-based cognitive-behavioral therapy; PPI, positive psychology intervention; WLC, waitlist condition.

differences are controlled for because they are included as a repeated measure in the analyses. Furthermore, as expected given the randomized treatment assignment, none of the baseline group differences reported here was significant after Bonferroni correction for multiple testing.

Dropout Analyses

To analyze predictors of dropout, we distinguished between dropout before posttreatment assessment (all 3 conditions) and dropout before follow-up assessment (excluding the WLC group). For each of the 2 dropout measures, logistic regression analysis were carried out using condition and all baseline variables as predictors. Dropout before posttreatment assessment did not differ between the conditions nor was it predicted by any baseline characteristic (all *P*s > 0.260). Dropout before follow-up assessment was also unrelated to condition (iCBT vs. PPI) and baseline characteristics, although there was a trend that older people ($P = 0.058$) and higher educated people ($P = 0.078$) more often provided follow-up data (all other *P*s > 0.136). Age and education were included as covariates.

Primary Outcome Variables

Table 3 displays the means of the primary and secondary outcome variables for the 3 conditions at each timepoint. Table 4 shows the results of the mixed regression models for the posttreatment analyses of the primary outcomes. Significant differences between iCBT and WLC and between PPI and WLC were found at posttreatment for the primary outcome variables happiness and depression. Both interventions led to a significant increase in happiness and a significant decrease in depression immediately posttreatment as compared with WLC. PPI led to a somewhat larger increase in happiness than iCBT, and this difference at posttreatment just attained significant at the level of $P = 0.05$. Table 5 shows the results of the follow-up analyses. Because the WLC did not have a follow-up assessment, only iCBT and PPI were compared. There were no differences between the 2 treatments at 6-month follow-up, neither for depression nor for happiness.

Figs. 2, 3 show the time course of happiness and depression per condition based on predicted outcome values from the mixed regression analyses. As can be seen

TABLE 3. Means and SDs (in Brackets) of Primary and Secondary Outcome Variables Per Timepoint Per Group

	WLC	PPI	iCBT
Primary outcome variables			
HADS depression			
Baseline	7.20 (3.32)	7.82 (4.21)	7.33 (3.42)
Post	7.73 (3.27)	5.25 (3.77)	4.99 (2.86)
Follow-up		5.47 (4.00)	5.30 (3.02)
Happiness			
Baseline	4.00 (0.93)	3.63 (1.11)	3.80 (0.86)
Post	3.85 (0.99)	4.47 (0.84)	4.35 (0.83)
Follow-up		4.25 (1.06)	4.23 (0.90)
Physical impairment (FIQ)			
Baseline	21.22 (5.71)	20.23 (5.69)	19.46 (5.40)
Post	20.63 (5.86)	18.76 (5.96)	17.94 (5.44)
Follow-up		18.65 (5.84)	18.37 (6.12)
Secondary outcome variables			
HADs anxiety			
Baseline	7.31 (3.75)	8.04 (4.74)	9.05 (4.06)
Post	7.27 (3.58)	5.93 (4.42)	6.63 (3.41)
Follow-up		6.02 (4.44)	6.12 (3.13)
Pain intensity			
Baseline	6.44 (1.46)	6.42 (1.70)	6.11 (2.05)
Post	6.20 (1.99)	6.12 (2.04)	5.71 (2.25)
Follow-up		6.09 (2.02)	5.86 (1.87)
Self-compassion			
Baseline	55.69 (11.62)	47.87 (14.29)	49.13 (12.90)
Post	55.54 (10.86)	57.75 (11.62)	57.53 (11.63)
Follow-up		59.11 (15.09)	57.42 (11.80)
Positive affect			
Baseline	26.72 (4.97)	24.18 (5.28)	24.96 (5.16)
Post	25.27 (4.83)	28.81 (5.28)	29.95 (4.77)
Follow-up		27.56 (5.41)	29.14 (4.50)
Negative affect			
Baseline	22.34 (5.60)	23.64 (6.34)	23.42 (5.88)
Post	22.56 (5.99)	18.31 (5.86)	18.16 (5.68)
Follow-up		20.20 (6.08)	20.47 (5.65)
Optimism (LOT-R)			
Baseline	20.80 (4.00)	19.15 (4.35)	19.71 (3.58)
Post	20.10 (3.83)	21.91 (4.73)	22.33 (4.04)
Follow-up		21.67 (4.36)	22.28 (3.45)
Flexible goal adjustment			
Baseline	35.68 (5.56)	32.24 (8.25)	32.78 (8.14)
Post	34.93 (7.24)	36.75 (8.30)	36.35 (7.74)
Follow-up		37.25 (8.81)	38.51 (7.03)
PCS			
Baseline	17.49 (9.32)	20.12 (11.67)	19.20 (10.54)
Post	17.02 (10.88)	14.34 (10.41)	12.91 (8.30)
Follow-up		11.87 (9.07)	12.23 (8.10)
Perseverative thinking			
Baseline	23.82 (11.87)	29.27 (13.33)	28.46 (13.11)
Post	22.18 (11.07)	23.63 (14.40)	22.32 (10.35)
Follow-up		20.36 (12.55)	21.91 (9.19)
Helplessness (ICQ-H)			
Baseline	14.00 (3.63)	14.97 (4.00)	14.49 (3.90)
Post	14.15 (3.51)	12.51 (4.22)	11.87 (3.79)
Follow-up		11.89 (3.74)	12.28 (4.09)
Acceptance (ICQ-A)			
Baseline	14.45 (3.46)	13.83 (3.64)	13.96 (3.61)
Post	15.51 (3.33)	15.95 (4.36)	16.55 (3.49)
Follow-up		17.02 (4.00)	16.42 (2.94)
Disease benefit (ICQ-B)			
Baseline	15.57 (4.14)	14.04 (4.56)	13.09 (4.48)
Post	15.62 (4.11)	16.10 (5.06)	16.09 (4.21)
Follow-up		16.69 (4.97)	15.81 (4.73)

FIQ indicates Fibromyalgia Impact Questionnaire; HADS, Hospital Anxiety and Depression Scale; iCBT, internet-based cognitive-behavioral therapy; ICQ, Illness Coping Questionnaire; LOT-R, Life Orientation Test-revised; PCS, pain catastrophizing; PPI, positive psychology intervention; WLC, waitlist condition.

from the figures, the improvements in depression and happiness were largely maintained at 6-month follow-up. Multilevel regression analysis within conditions showed that levels of depression and happiness at 6 months were still significantly different from the pretreatment assessment in both treatment conditions. Rerunning the model with posttreatment as the reference timepoint indicated that depression showed a slight but significant increase from posttreatment to follow-up in the iCBT condition only (B[SE] = 0.64[0.29]; P = 0.034). Both conditions showed a slight decrease in happiness from posttreatment to follow-up, and this change was significant within the PPI group (B[SE] = 0.25[0.11]; P = 0.032).

The third primary outcome, physical impairments, did not show a significant time by condition interaction at posttreatment. There was a significant decrease in physical impairments at posttreatment in the 2 active treatment conditions, but this did not differ significantly from the decrease in the WLC. Also PPI and iCBT did not differ from each other at follow-up.

Secondary Outcome Variables

Results of the mixed regression analyses for secondary outcomes are displayed in Supplementary tables S1 (Supplemental Digital Content 1, http://links.lww.com/CJP/A427) and S2 (Supplemental Digital Content 2, http://links.lww.com/CJP/A428). Significant differences were found at posttreatment between iCBT and WLC, and between PPI and WLC for anxiety, positive and negative affect, self-compassion, optimism, FGA, pain catastrophizing, acceptance, disease benefits, and helplessness (all in the expected direction). The iCBT condition additionally led to a significant increase in disease benefits compared with WLC. There were no significant differences at posttreatment or follow-up between iCBT and PPI for any of the secondary outcomes. All improvements were maintained until 6-month follow-up as shown by the within condition mixed regression analyses. The change from baseline to 6-month follow-up assessments was still significant and there were no significant change from posttreatment to follow-up.

For pain intensity and perseverative thinking no significant time, condition, or time by condition effects were found at posttreatment or follow-up.

Moderation by Sex and Educational Level

Moderation by sex was tested by testing the condition by time by sex interaction in each of the 2 sets of analyses, the one with the WLC group and without the follow-up, and the one without the WLC and with the follow-up (for details of the moderation models, see the Statistical analyses part of the Materials and Methods section). No moderation by sex was found for any of the primary or secondary outcome variable (P > 0.05 for all LR tests of the 3-way interaction on primary outcomes, P > 0.01 for all secondary outcomes).

Moderation by educational level was tested by adding the condition by time by education interaction to the model, with education as an ordinal covariate instead of with dummy coding to improve power (LR tests of the model with education via dummy coding versus the model with education as a covariate supported the latter simplification, P > 0.05 for both outcomes and both analyses, with and without the WLC). Moderation by education was found for 2 of the 3 primary outcomes. For depression,

TABLE 4. Estimated Difference (B) and 95% CI in Primary Outcome Variables for the Comparison PPI Versus WLC, iCBT Versus WLC, and PPI Versus iCBT, at Posttreatment Based on Intention-to-Treat Analyses

	B (SE)	95% CI	P	Effect Size	95% CI
Depression (HADS-D)					
PPI vs. WLC	−2.61 (0.55)	−3.70 to −1.53	< 0.001	−0.777	−1.103 to −0.456
iCBT vs. WLC	−2.46 (0.55)	−3.55 to −1.37	< 0.001	−0.733	−1.057 to −0.408
PPI vs. iCBT	−0.15 (0.44)	−1.03 to 0.73	0.738	−0.046	−0.307 to 0.218
Happiness					
PPI vs. WLC	0.86 (0.16)	0.54-1.19	< 0.001	0.983	0.617-1.360
iCBT vs. WLC	0.60 (0.17)	0.27-0.92	< 0.001	0.686	0.309-1.051
PPI vs. iCBT	0.27 (0.13)	0.02-0.53	0.048	0.309	0.003-0.618
Physical impairment (FIQ)					
PPI vs. WLC	−0.56 (0.74)	−2.03 to 0.99	0.451	−0.099	−0.359 to 0.175
iCBT vs. WLC	−0.30 (0.75)	−1.78 to 1.18	0.697	−0.053	−0.315 to 0.209
PPI vs. iCBT	−0.27 (0.61)	−1.47 to 0.93	0.662	−0.048	−0.260 to 0.165

Effect sizes and 95% confidence interval of effect sizes are displayed in the last columns. All models were adjusted for age, sex, and educational level.
CI indicates confidence intervals; FIQ, Fibromyalgia Impact Questionnaire; HADS, Hospital Anxiety and Depression Scale; iCBT, internet-based cognitive-behavioral therapy; PPI, positive psychology intervention; WLC, waitlist condition.

the LR test showed a condition by time by education interaction in the analysis including the WLC and excluding the follow-up ($\chi^2 = 8.44$; $df = 2$; $P = 0.019$) and also in the analysis excluding the WLC and including the follow-up ($\chi^2 = 6.43$; $df = 2$; $P = 0.040$). Simple effect analyses per educational level showed 2 things. First, both iCBT and PPI were significantly more effective than WLC at posttest for each educational level, although the effect was largest for low education, and smallest for high education. Second, for low and medium educational level, iCBT and PPI did not significantly differ from each other either at posttest or at follow-up, but for higher educated patients, PPI was more effective than iCBT (B[SE] = −1.22[0.61]; $P = 0.049$ at postintervention and (B[SE] = −1.35[0.63]; $P = 0.035$ at follow-up). The predicted outcome values for depression over time per education group are shown in Figure 4.

Also for happiness there was a significant condition by education interaction in both analyses, the one with the WLC group without the follow-up ($\chi^2 = 8.81$; $P = 0.012$) and the one without the WLC group with the follow-up ($\chi^2 = 6.13$; $P = 0.047$). Simple effect analyses within the 3 educational groups showed again 2 things. First, iCBT and PPI were both more effective than WLC at posttest for each educational level, albeit not significantly for iCBT in the high education subgroup, and the effect was again largest for low education and smallest for high education. Second, for low and medium educational level, iCBT and PPI did not significantly differ from each other either at posttest or at follow-up, but for highly educated patients PPI was more effective than iCBT at postintervention (B[SE] = 0.51[0.16]; $P = 0.002$) and

follow-up (B[SE] = 0.55 [0.25]; $P = 0.029$). Figure 5 shows the predicted values for happiness over time per education group.

The treatment effect on the third primary outcome, physical impairment, was not moderated by education level. Using $P > 0.01$ for the secondary outcome variables did not indicate a significant moderation effect for these variables either. Positive affect did show a trend toward moderation both for the comparison using the WLC group without the follow-up ($\chi^2 = 7.52$; $P = 0.023$) and the comparison without the WLC group with the follow-up ($\chi^2 = 7.28$; $P = 0.026$). However, simple effect analyses within the 3 educational groups did not indicate any differences between the 2 active conditions.

Clinical Relevance

Figures 6 and 7 show the percentage of cases, doubtful cases, and noncases for depression and anxiety per condition at pretreatment and posttreatment. For the PPI and iCBT condition also the percentages at 6-month follow-up are displayed. As can be seen from the figures the percentage of (doubtful) cases of depression and anxiety remained approximately the same in WLC, whereas there was a clear decrease in both PPI and iCBT postintervention, which remained stable until 6-month follow-up. For depression, the percentage of (doubtful) cases decreased by 54% after PPI and by 50% after iCBT at postintervention. For anxiety the decrease in (doubtful) cases was 42% for PPI and 43% for iCBT.

Differences in the number of (doubtful) cases for depression and anxiety between the 3 conditions

TABLE 5. Estimated Difference (B) and 95% CI in Primary Outcome Variables for the Comparison of PPI Versus ICBT at Follow-up

	B (SE)	95% CI	P	Effect Size	95% CI
Depression (HADS-D)					
PPI vs. iCBT	−0.60 (0.50)	−1.59 to 0.39	0.236	−0.162	−0.431 to 0.106
Happiness					
PPI vs. iCBT	0.17 (0.19)	−0.21 to 0.55	0.389	0.164	−0.203 to 0.531
Physical impairment (FIQ)					
PPI vs. iCBT	−0.27 (0.72)	−1.69 to 1.14	0.705	−0.046	−0.287 to 0.194

All models were adjusted for age, sex, and educational level.
CI indicates confidence intervals; FIQ, Fibromyalgia Impact Questionnaire; HADS, Hospital Anxiety and Depression Scale; iCBT, internet-based cognitive-behavioral therapy; PPI, positive psychology intervention.
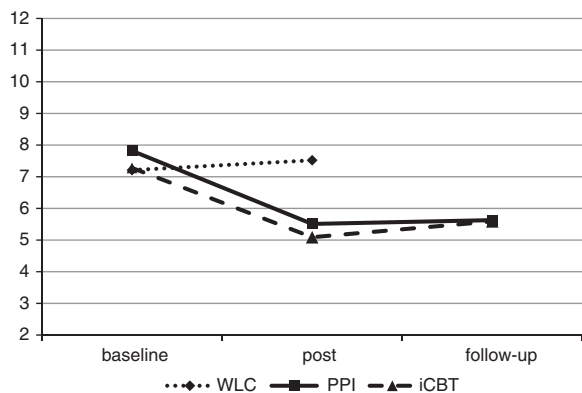
FIGURE 2. Predicted values from the mixed regression model for depression in the 3 treatment groups at baseline, immediately after the intervention, and at 6-month follow-up. iCBT indicates internet-based cognitive-behavioral therapy; PPI, internet positive psychology intervention; WLC, waitlist condition.

postintervention and between iCBT and PPI at follow-up were tested by means of mixed logistic regression analysis. It should be noted that whereas percentages displayed in the figures are based on a variable number of participants at various timepoints, the mixed logistic regression analyses take all participants with a baseline assessment into account. The results of the mixed regression showed that at postintervention, the decrease in number of (doubtful) depression cases was significantly stronger after PPI (B = −1.12[0.37]; *P* = 0.003) and iCBT (B = −1.10[0.39]; *P* = 0.005) than after WLC. The decrease did not differ between PPI and iCBT, either at postintervention or at follow-up. Similarly for anxiety, the decrease in (doubtful) caseness was significantly stronger after PPI (B = −1.15[0.40]; *P* = 0.004) and iCBT (B = −1.38[0.40]; *P* = 0.001) than after WLC, with no difference between the 2 active conditions.

DISCUSSION

This study sought to evaluate the efficacy of an internet-based PPI for patients with chronic musculoskeletal pain by comparing its effect with that of an existing
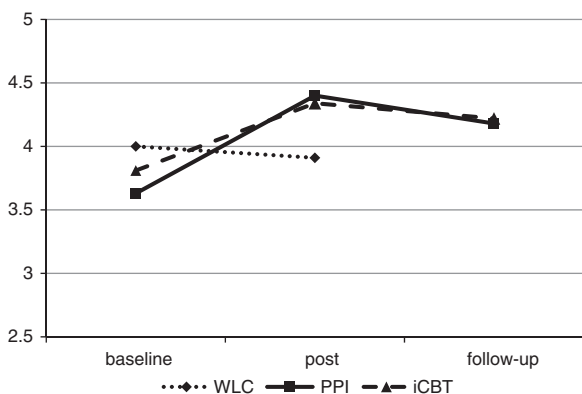

FIGURE 3. Predicted values from the mixed regression model for happiness in the 3 treatment groups at baseline, immediately after the intervention, and at 6-month follow-up. iCBT indicates internet-based cognitive-behavioral therapy; PPI, positive psychology intervention; WLC, waitlist condition.

iCBT intervention and a WLC. The results show that the newly developed PPI had a significant effect on 2 of our primary outcomes, namely depression and happiness. There was no significant difference with the iCBT condition but compared with the WLC, effect sizes were large across both active interventions. Significant posttreatment and follow-up effects were also obtained for most of the secondary outcomes, namely anxiety, positive and negative affect, self-compassion, optimism, either "flexible goal adjustment" of "FGA", pain catastrophizing, helplessness, and pain acceptance, with medium effect sizes compared with the WLC at posttreatment. Beneficial effects for primary and secondary outcomes were maintained at 6-month follow-up. However, PPI nor iCBT led to a significant decrease in physical impairments, our third primary outcome, compared with the WLC.

Positive psychology exercises have been found effective in decreasing depressive feelings and increasing happiness in community samples as well as in people with mild to moderate depression.[11,12] Their usefulness for relieving suffering in chronic pain patients has so far received scarce attention, despite theoretical accounts proposing the added value of interventions specifically focusing on increasing positive states and traits.[5,7] To our knowledge there is only 1 previous RCT examining the effects of positive psychology exercises in patients with chronic pain.[14] This study found that a package of 4 individually tailored exercises led to decreases in pain intensity, depression, pain interference and pain catastrophizing and increased life satisfaction, positive affect and pain control, with small to moderate effect sizes. Most benefits remained until 2.5-month follow-up. However, for many of the outcomes the control group showed similar benefits and at follow-up there were no longer significant differences between the groups. Because there might have been an active ingredient in the control condition as well (ie, journaling about daily activities), the results were somewhat difficult to interpret. Nevertheless as this was primarily a feasibility and acceptability study, the study did show that internet-based PPIs have potential. This potential is further underlined by the present study.

In addition to the self-help exercises used in the present study and the previous study by Müller, other interventions that can be situated within the domain of positive psychology have been examined for their efficacy in helping people to cope with chronic pain. Examples are solution-focused therapy,[46] Loving Kindness Meditation,[10] and a mindfulness-based program complemented with principles from positive psychology (eg, savoring).[47] These interventions have also been found helpful, although for each of these interventions there is only preliminary evidence from small scale or pilot studies. Our study is the largest RCT so far on the usefulness of positive psychology techniques for chronic pain. Moreover, in contrast to the interventions described above which included group sessions led by a therapist, our program was based on self-help exercises. The absence of therapist involvement may greatly increase accessibility and dissemination potential. It should be noted that in the current trial psychology students provided assistance and encouragement to reduce dropout, but refrained from any therapeutic intervention. The trade-off of the large dissemination potential of internet interventions are the usually high attrition rates.[48] Previous studies reported that PPIs may be more engaging and fun and therefore may have better retention than internet interventions using a more traditional approach (eg, CBT[49,50]),
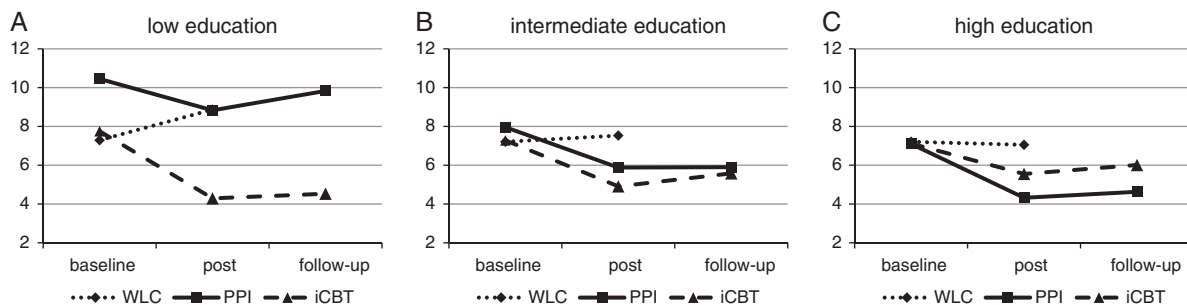
FIGURE 4. Predicted values from the mixed regression model for depression per group and per timepoint for participants with low (n = 38) (A), intermediate (n = 109) (B), and high education (n = 128) (C).

but we did not see this in the current trial. Telephone, internet, or e-mail guidance can improve adherence,[51] but may make large-scale dissemination less feasible. Automated guidance or user platforms could be one solution.

Although the internet-based PPIs was effective and yielded relatively large effects sizes it was not more efficacious than the iCBT intervention. A small advantage was found for PPI compared with iCBT on increases in happiness immediately posttreatment, but at 6-month follow-up this advantage had disappeared. This finding is very similar to what has been found in other RCTs comparing different interventions for chronic pain. For instance, a recent large trial comparing mindfulness-based stress reduction (MBSR) with CBT and treatment as usual found no significant differences in effectiveness between MBSR and CBT, although both were associated with greater improvement in back pain and functional limitations compared with treatment as usual.[52] In addition, meta-analysis has shown that mindfulness-based interventions and Acceptance and Commitment Therapy are equally effective in lowering depression and anxiety in chronic pain, with effect sizes comparable with those after CBT.[53]

Interestingly, the effects of the iCBT intervention seemed to be more extensive and affected a larger range of outcomes than what was found in previous studies using this intervention.[27,28] Whereas the previous studies mainly found an effect on pain catastrophizing, with no decrease in depression, the present study did find large and clinically significant effects on depression. What exactly underlies this apparently increased efficacy is unknown. Although some of the texts were slightly adapted, the content was basically the same.

Neither intervention significantly decreased physical impairments or pain intensity. The absence of an effect of a psychological intervention on pain intensity is a common

finding.[54] Most interventions, including the present one, aim to improve functioning and quality of life and decrease distress, but are not directly targeting pain reductions. Decreased disability has been reported after psychological interventions, although this effect often seems short-lived.[54] We used 9 items from the FIQ to measure physical impairments, which basically assesses the ability to perform large muscle tasks. It might be speculated that our interventions not so much affected functional abilities itself, but rather the motivation to engage in these activities. This may be better captured by interference measures such as the pain interference scale of the BPI[55] or the PROMIS interference items.[56]

Comparison of the 2 active interventions suggested a slight advantage of PPI over iCBT for the primary outcomes in patients with a higher education. For patients with a lower or medium education level the difference between the PPI and iCBT condition did not reach significance but this might have resulted from lower power for these comparisons because of a smaller number of patients in low and intermediate education groups. The raw data and graphs suggest that for lower educated patients the iCBT intervention might have been more effective. In fact, the post-treatment change scores indicated that for PPI the decrease in depression and the increase in happiness became larger as a function of the level of education, whereas the opposite was seen for iCBT. The positive psychology exercises may require a certain level of cognitive and intellectual functioning to be able to maximally engage in and optimally profit from the exercises. Many previous studies showing the efficacy of positive psychology exercises have been performed in university students. Interestingly, a recent study found that participants scoring higher on intelligence reported stronger increases in happiness after a PPI.[57] The iCBT exercises may have required less cognitive and
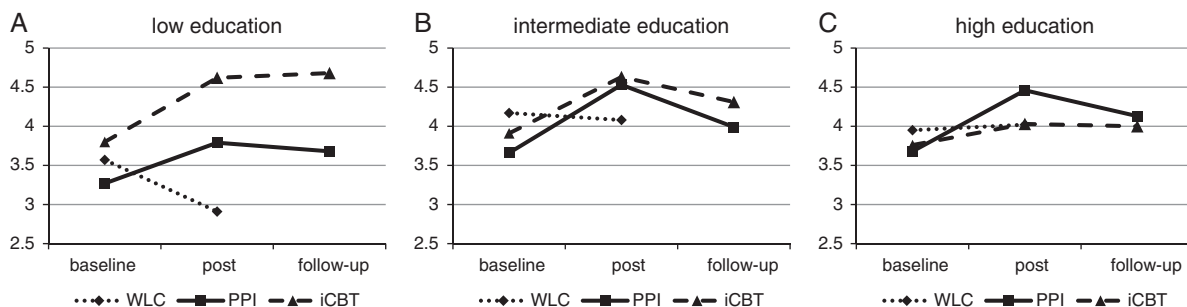

FIGURE 5. Predicted values from the mixed regression model for happiness per group and per timepoint for participants with low (n = 38) (A), intermediate (n = 109) (B), and high education (n = 128) (C).
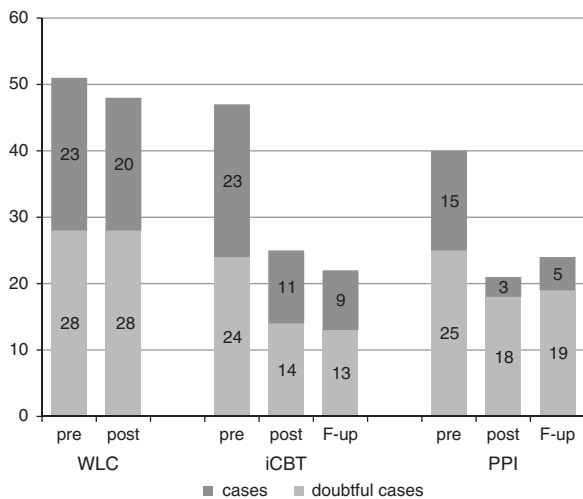
FIGURE 6. Percentage of cases (HADS-D>10) and doubtful cases (HADS-D=8 to 10) for depression at the 2 (WLC) and 3 (iCBT, PPI) assessment points in the 3 conditions. Cases and doubtful cases are represented as percentage of all patients in that group at that timepoint. HADS indicates Hospital Anxiety and Depression Scale; iCBT, internet-based cognitive-behavioral therapy; PPI, positive psychology intervention; WLC, waitlist condition.

intellectual abilities because they were more concrete and written in plain language. This may have been advantageous for lower educated people, but patients with a higher education might have become annoyed by the somewhat overly simple language that we noticed when translating the texts. Because education effects were not a priori predicted, results should be viewed with caution and future studies should confirm whether indeed positive psychology self-help exercises are most useful for people with higher educational levels.
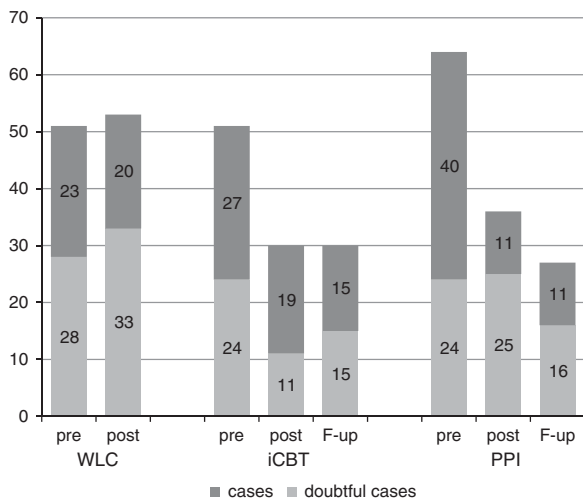

FIGURE 7. Percentage of cases (HADS-A>10) and doubtful cases (HADS-A=8 to 10) for anxiety at the 2 (WLC) and 3 (iCBT, PPI) assessment points in the 3 conditions. Cases and doubtful cases are represented as percentage of all patients in that group at that timepoint. HADS indicates Hospital Anxiety and Depression Scale; iCBT, internet-based cognitive-behavioral therapy; PPI, positive psychology intervention; WLC, waitlist condition.

The PPI consisted of 4 different exercises. These exercises were selected on the basis of available evidence for their efficacy in inducing positive states in various populations. Specifically, the exercises targeted self-compassion, positive affect and optimism, all of which have been associated with better chronic pain coping.[7,17–19] The intervention had the intended effect, and significantly increased self-compassion, positive affect, and optimism, both at posttreatment and at follow-up. However, as similar increases in these variables were found after iCBT, the mechanisms underlying both interventions may be less specific than assumed. Indeed, the distinctiveness of the pathways along which different pain treatments achieve their gains has recently been challenged.[58,59] Even though CBT, MBSR, and acceptance and commitment therapy originate from different theoretical conceptualizations they seem to act through shared underlying mechanisms. Because the content and targets of our PPI were quite different from other pain interventions, that is, none of the exercises in PPI specifically addressed pain, we did expect to find differences between PPI and iCBT on the process variables. Future analyses of the weekly data that were also collected may possibly reveal differences in the timing and trajectories of the various process variables. Nevertheless it cannot be excluded that also PPI acts upon the same underlying mechanisms as interventions that are more pain focused.

Although the choice of exercises in the PPI was theory-driven, we do not know whether the selection and duration (1 or 2 weeks) of these exercises, and the sequence of the modules were optimal. Our design does not allow assessing the effectiveness of each exercise separately, or whether all 4 exercises are necessary and contribute to outcome. Programs offering a variety of positive exercises have been advocated as being more beneficial than single exercises, although there may be a limit to this.[49] A study comparing the efficacy of a 6-week program consisting of 2, 4, or 6 different positive psychology exercises suggested that a program with 4 exercises was most efficacious in decreasing depressive symptoms, and that efficacy declined when participants were given a new exercise every week.[60] Future trials could confirm the added value of each of the individual exercises by using a dismantling technique, systematically leaving 1 exercise out.

The study also had some limitations. First, there was a considerable dropout. Around 25% of the patients across the 3 conditions did not provide posttreatment data. Dropout at follow-up was on an average 55% for the 2 conditions. Although dropout analyses did not indicate systematic differences between patients providing posttreatment and/or follow-up data and those that did not, and although the mixed regression analyses takes all available data into account, some influence on the results cannot be excluded. Second, because patients in the control group were allowed to commence treatment after the 8-week waiting period, we could not examine long-term effect in comparison with the control condition. Analyses within the treatment groups indicated, however, that the beneficial effects were largely maintained until 6-month follow-up. Third, patients responded to announcements on a patient website or advertisement in newspapers and thus were self-selected to participate in an internet intervention. Moreover, patients not being able to perform simple exercises, those with degenerative muscle, heart or vascular diseases and patients with psychiatric conditions or recent psychological treatment were excluded. It is not known how

well the results will generalize to patients in other settings or with more severe conditions and comorbidities. Finally we have no data regarding the frequency and intensity with which patients engaged in the exercises, and whether patients providing posttreatment data actually completed all modules. Future studies should try to gain more insight in the amount of time actually spent exercising to examine a dose-response relationship.

This study has important clinical implications. The efficacy of a positive psychology internet intervention to decrease distress and increase mental well-being in patients with chronic pain could be demonstrated in self-selected patients completing the course. Effect sizes were moderate to large and the beneficial effects were maintained until 6 months later. The effects in the current trail also seemed to be clinically relevant. The number of (doubtful) cases of depression was substantially reduced. Comorbid depression is a considerable problem in patients with chronic pain, with typical prevalence rates of 30% to 50%. Pain management is less successful in patients with comorbid depression,[61,62] and the presence of depression has been related to increased suicide risk in patients with chronic pain.[63] Hence, depression is an important target for treatment. Moreover, the intervention not only reduced depression and other negative emotional states, it also significantly increased happiness. This increase seemed to be quite substantial in terms of the percentage of patients reporting being "happy" or "very happy." At baseline 23% of patients reported to feel (very) happy and this increased to 58% immediately postintervention and to 49% at 6-month follow-up. In combination with the significant improvements that were found on the other positive state and trait variables (ie, acceptance, disease benefits, and optimism), this suggests that positive psychology internet intervention can promote positive well-being in patients with chronic pain.

Can an internet-based positive psychology self-help intervention be recommended as stand-alone treatment for chronic pain? Programs such as these, delivered over the internet with minimal guidance, have the advantage of high accessibility at low costs. Thereby large numbers of pain patients can potentially be reached, also patients who otherwise would be unable or reluctant to seek treatment. Consequently, even moderate effects may have a large societal impact. Nevertheless, benefits were mostly restricted to the affective domain, leaving pain intensity and functioning unaffected. As these are also important outcomes for patients and other interventions have been shown to be able to increase functional capacity and to a lesser extend decrease pain intensity, one could argue that the PPI intervention could best be used as an add-on to existing treatment instead of a stand-alone intervention. Because alleviating affective symptoms might be the key to successful pain rehabilitation,[61,62] addressing these with PPI before entering a pain management program might increase its effectivity. Preliminary evidence has shown that adding an emotion regulation intervention to exposure-based treatment for chronic pain led to more prominent improvements in pain and disability compared with "standard" exposure treatment for chronic pain.[64] Another interesting possibility is that using PPI in adjunct to other treatments could prevent relapse through empowerment of patients. Future studies should examine whether adding PPI to existing pain management programs could indeed increase their effectivity and reinforce long-term efficacy.

Another aspect that should be further examined is who profits most from an internet PPI, and who will be better off with iCBT. The present study already hinted to an effect of education. Another moderator might be preference of the individual. For some, positive psychology may be too vague or controversial, whereas others may be particularly attracted to this fresh approach that recently has become popular. Thus PPI might be better for some patients than for others, be it as a stand-alone or an add-on intervention. For clinicians, being acquainted with PPI techniques will provide them with a larger tool box which they can apply as adjunct treatment, or offer to their patients as empowerment strategy before treatment or afterwards to prevent relapse.

In conclusion, the newly developed PPI as well as more traditional CBT each have potential for self-management of chronic pain. Future research should identify whether combining it with established pain treatment approaches has additional benefit.

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