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Catastrophizing and pain-related fear predict failure to maintain treatment gains following participation in a pain rehabilitation program

Emily Moore[a], Pascal Thibault[a], Heather Adams[b], Michael J.L. Sullivan[b,*]

Abstract

The present study explored whether pain-related psychosocial risk factors played a role in determining whether treatment gains were maintained following participation in a rehabilitation intervention for musculoskeletal injury. The study sample consisted of 310 individuals (163 women, 147 men) with work-related musculoskeletal conditions who were enrolled in a physical rehabilitation program. Measures of pain severity, pain catastrophizing and pain-related fear were completed at the time of admission and at the time of discharge. Pain severity was assessed again at 1-year postdischarge. Participants were classified as "recovered" if they showed a decrease in pain of at least 2 points and rated their pain at discharge as less than 4/10. Recovered participants were considered to have failed to maintain treatment gains if their pain ratings increased by at least 2 points from discharge assessment to 1-year follow-up, and they rated their pain as 4/10 or greater at 1-year follow-up. The results of a logistic regression revealed that participants with high posttreatment scores on measures of catastrophizing and fear of pain were at increased risk of failing to maintain treatment gains. The findings suggest that unless end-of-treatment scores on catastrophizing and fear of pain fall below the risk range, treatment-related reductions in pain severity may not be maintained in the long term. The clinical and theoretical implications of the findings are discussed.

Keywords: Pain, Catastrophizing, Fear of pain, Relapse, Pain reduction

1. Introduction

Persistent musculoskeletal pain is currently the most expensive nonmalignant health condition affecting the North American working-age population.[4,12,22,46] Musculoskeletal conditions involving the spine (ie, back and neck conditions) represent the single largest category of injury for which time loss claims are made. In the North America alone, the annual direct costs associated with musculoskeletal injuries have been estimated to be in excess of 25 billion dollars.[1]

Activity-based interventions are currently advocated for the clinical management of individuals who have sustained musculoskeletal injuries.[8,50] Such interventions might include advice to remain active, physical therapy, or multidisciplinary rehabilitation. Although research has supported the benefits of activity-based interventions for musculoskeletal pain, there are indications that treatment gains made in activity-based interventions might not be maintained long-term by a substantial proportion of patients.[11,16,19,26,29,36,52] Little is currently known about the factors that influence whether treatment gains will be maintained or lost after rehabilitation interventions for musculoskeletal injury.

Pain-related psychosocial risk factors might play a role in determining whether treatment gains will be maintained following participation in a rehabilitation intervention for musculoskeletal injury. In previous research, pain catastrophizing and fear of pain have been shown to be significant determinants of treatment outcomes in individuals participating in rehabilitation interventions for musculoskeletal injury.[10,20,23,45,48] Pain catastrophizing and pain-related fear might also be determinants of failure to maintain treatment gains. In other words, it is possible that individuals whose posttreatment scores on measures of pain catastrophizing and fear of pain remain elevated at the completion of a rehabilitation intervention might be less likely to maintain treatment gains.

There are important clinical and theoretical implications to research addressing the determinants of the failure to maintain treatment gains in the rehabilitation of musculoskeletal injury. From a clinical perspective, failure to maintain treatment gains will be associated with higher treatment costs and longer periods of disability.[11,25] Failure to maintain treatment gains might also contribute to symptoms of emotional distress, or negative

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[a] Department of Psychology, McGill University, Montreal, QC, Canada, [b] Recover Injury Research Centre, University of Queensland, Brisbane, Queensland, Australia

**Corresponding author. Address: Recover Injury Research Centre, University of Queensland, 288 Herston Rd, Level 7, Herston, Brisbane 4006, Queensland, Australia. E-mail address: mick.sullivan@uq.edu.au (M.J.L. Sullivan).*

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recovery expectancies, further compromising an individual's recovery potential.[14] From a theoretical perspective, increased knowledge about the time-dependent and sequential relations among pain symptoms and psychosocial factors will bring greater precision and predictive power to biospychosocial models of pain and disability.[13,33,47]

The present study explored the relation between posttreatment scores on pain-related psychosocial risk factors and the maintenance of treatment gains. Work-disabled individuals participating in a rehabilitation intervention for musculoskeletal injury completed pretreatment and posttreatment measures of pain severity, pain catastrophizing, and fear of pain. Maintenance of treatment gains was assessed at 1-year follow-up. It was hypothesized that individuals whose posttreatment scores on measures of pain catastrophizing and fear of pain remained elevated would be at increased risk for failure to maintain the treatment gains made through their participation in a rehabilitation intervention.

2. Methods

2.1. Participants

The participant sample consisted of 310 individuals (163 women, 147 men) with work-related musculoskeletal conditions who were referred for treatment at 1 of the 5 collaborating pain rehabilitation clinics in the province of Quebec, Canada. At the time of evaluation, all participants were receiving wage indemnity benefits from the provincial worker's compensation board (Commission de la santé et de la sécurité du travail [CSST]). Most the participants were married or living common law (87%) and had completed high school (83%). Sample characteristics are presented in **Table 1**.

2.2. Procedure

The research program was approved by the research ethics committee of McGill University. Individuals were considered for participation if they had been referred to 1 of 5 collaborating rehabilitation clinics specializing in the treatment of musculoskeletal injury. Individuals were only considered for participation if they had sustained their injury no more than 12 months before the date of referral.

Participants signed a consent form before completing the study procedures. Participants were asked to complete measures of pain severity, pain catastrophizing, and fear of pain as part of their initial assessment. The same measures were readministered at termination of treatment. One year after the initial assessment, participants were contacted by telephone and were asked to answer questions relevant to their current symptoms. Participants were compensated $50 for completing the questionnaires and the telephone interview.

2.2.1. Rehabilitation intervention

The specific elements of the rehabilitation interventions varied at the clinicians' discretion. However, all interventions conformed to practice guidelines for early intervention for musculoskeletal problems consistent with reimbursement policies of the workers' compensation board emphasizing mobilization and activity.[32] All interventions were characterized by a functional restoration orientation consisting primarily of medical management, physical therapy, education, and instruction in self-management skills. The intervention teams consisted of a physician, physiotherapist, occupational therapist, and psychologist. The exercise intervention was individually tailored to clients' needs, whereas the education and instruction in self-management intervention were provided in group format. Treatment duration varied from 4 to 7 weeks.

Table 1

Characteristics of the study sample (N = 310).

Characteristics	n (%) or mean (SD)
Sex (M/F)	147 (47%)/163 (53%)
Education	
Less than high school	53 (17%)
High school	88 (28%)
Trade school	61 (20%)
College	68 (22%)
University	40 (13%)
Occupation	
Laborer	102 (33%)
Nursing	81 (26%)
Clerical	55 (18%)
Driver	18 (6%)
Trade	35 (11%)
Sales	19 (6%)
Pain site (categories are not mutually exclusive)	
Back	288 (93%)
Neck	258 (83%)
Upper extremity	194 (63%)
Lower extremity	76 (24%)
Pretreatment	
Pain severity (0/10)	5.4 (1.4)
Pain duration, wk	10.5 (5.6)
PCS	21.3 (10.6)
TSK	42.6 (6.1)

SD, standard deviation.

2.3. Measures

2.3.1. Pain severity

Participants were asked to rate the severity of their current pain on a numerical rating scale with the endpoints (0) no pain at all and (10) excruciating pain.

2.3.2. Catastrophizing

The Pain Catastrophizing Scale (PCS)[39] was used to assess catastrophic thinking related to pain. The PCS consists of 13 items describing different thoughts and feelings that individuals might experience when they are in pain. The PCS has been shown to have high internal consistency (coefficient alpha = 0.87) and to be associated with heightened pain, disability, as well as employment status.[39,43,44] On the basis of previous research on meaningful cut scores on the PCS, participants with PCS scores greater than or equal to 24 were classified as high catastrophizers.[35]

2.3.3. Fear of pain

The Tampa Scale for Kinesiophobia (TSK)[21] was used as a measure of fear of pain. The TSK is a 17-item questionnaire that assesses fear of (re)injury due to movement. The TSK has been shown to be internally reliable (coefficient alpha = 0.77).[51] The TSK has been associated with various indices of behavioral avoidance and disability.[6,28,44] On the basis of previous research on meaningful cut scores on the TSK, participants with TSK scores greater than or equal to 40 were classified as high fear.[2,28]

2.3.4. Follow-up interview

One year after termination of the rehabilitation treatment, participants were contacted by telephone and were interviewed

about their current symptoms. Participants were asked to verbally report their pain intensity on a numerical rating scale with the endpoints (0) *no pain at all* and (10) *excruciating pain*.

2.4. Data analytic approach

There were no significant differences due to clinical site on any of the study variables. As such, all analyses are reported with data collapsed across the 5 rehabilitation clinics that served as sites of recruitment.

All participants reported at least moderate pain (pain rating ≥4/10) at initial assessment. Participants were classified as having "recovered" if (1) their pain score decreased by 2 points or more from admission to discharge, and (2) their pain score was less than 4/10 at discharge. The approach to defining successful response to treatment is consistent with research on meaningful cut scores on pain severity scales and IMMPACT recommendations for interpreting pain treatment outcomes.[9,17] T tests for independent samples and χ^2 analyses were used to compare recovered and nonrecovered participants on study measures. Cohen's *d* values are reported as estimates of effect size for mean comparisons.

Recovered participants were considered to have failed to maintain treatment gains if (1) their follow-up pain rating had increased by at least 2 points, relative to the discharge evaluation, and (2) their 1-year follow-up pain score was in the moderate to severe range (pain rating ≥4/10). Logistic regression was used to assess the value of posttreatment PCS and TSK scores in predicting failure to maintain treatment gains. These analyses were conducted with PCS and TSK scores used as continuous variables and dichotomized on recommended cut scores. Tolerance coefficients were greater than 0.60 indicating no problem of multicollinearity. All analyses were conducted with SPSS Version 21.

3. Results

3.1. Sample characteristics

Demographic information and mean scores on measures of pain severity, pain catastrophizing, and fear of movement are presented in **Table 1**. The mean scores on pain catastrophizing and fear of movement were comparable (within 1 SD) with those reported in previous research on work-disabled participants with musculoskeletal pain.[3,7,38] Pain ratings at admission ranged from 4/10 to 9/10 indicating that participants were experiencing moderate to severe pain at initial assessment.

3.2. Variables associated with recovery outcomes

Participants were considered to have recovered if they showed at least 2-point reduction in pain through the course of the rehabilitation intervention, and their posttreatment pain rating was below 4/10. On the basis of this definition, 185 participants (60%) recovered. Likelihood of recovery did not vary significantly as a function of sex, $\chi^2 = 2.3$, ns; marital status, $\chi^2 = 1.5$, ns; education, $\chi^2 = 2.1$, ns; occupation, $\chi^2 = 2.2$, ns; or number of weeks of treatment, $\chi^2 = 1.7$, ns.

Table 2 shows the results of independent *t* tests comparing recovered and nonrecovered participants on various study measures. Participants classified as recovered had a shorter duration of their current pain episode, $t(308) = 3.2$, $P < 0.001$ ($d = 0.35$, 95% confidence interval [CI] = 0.12–0.57), rated their pain as less intense at admission, $t(308) = 3.1$, $P < 002$ ($d = 0.44$, 95% CI = 0.21–0.67), reported fewer pain sites, $t(308) = 2.0$, $P = 0.04$ ($d = 0.22$, 95% CI = 0.01–0.44), and obtained lower posttreatment scores on the PCS, $t(308) = 3.8$, $P < 0.001$ ($d = 0.43$, 95% CI = 0.21–0.66), and TSK, $t(308) = 2.7$, $P < 0.006$ ($d = 0.33$, 95% CI = 0.10–0.55).

Table 2
Variables associated with recovery outcomes (N = 310).

	Recovered (N = 185)	Not recovered (N = 125)	P
Age	36.0 (10.1)	36.6 (9.8)	0.60
Pain duration	10.2 (5.4)	12.7 (8.9)	0.001
Initial pain severity	5.0 (1.3)	5.6 (1.4)	0.002
Number of pain sites	2.5 (0.8)	2.8 (0.9)	0.04
Pretreatment PCS	20.8 (9.6)	21.6 (11.3)	0.52
Posttreatment PCS	10.7 (10.0)	15.4 (11.5)	0.001
Pretreatment TSK	42.2 (6.2)	43.3 (6.2)	0.14
Posttreatment TSK	37.5 (7.4)	39.7 (5.8)	0.006

Values in parentheses are standard deviations.

3.3. Variables associated with maintenance of treatment gains

Participants were considered to have failed to maintain treatment gains if they were classified as recovered at posttreatment, if their pain ratings increased by at least 2 points from posttreatment assessment to 1-year follow-up, and they rated their pain as 4/10 or greater at 1-year follow-up. On the basis of this definition, 70 participants (38%) failed to maintain treatment gains.

Table 3 shows the results of *t* tests comparing participants who did and did not maintain treatment gains on various study measures. Participants who failed to maintain treatment gains reported more intense pain at admission, $t(183) = 4.7$, $P < 0.001$ ($d = 0.74$, 95% CI = 0.44–1.0), reported more pain sites, $t(183) = 3.3$, $P = 0.001$ ($d = 0.58$, 95% CI = 0.29–0.88), and obtained higher pretreatment and posttreatment PCS and TSK scores (PCS pre, $t(183) = 4.4$, $P < 0.001$ ($d = 0.68$, 95% CI = 0.38–0.97): PCS post, $t(183) = 8.3$, $P < 0.001$ ($d = 1.2$, 95% CI = 0.86–1.5): TSK pre, $t(183) = 2.8$, $P < 0.005$ ($d = 0.42$, 95% CI = 0.13–0.71): TSK post, $t(183) = 6.0$, $P < 0.001$ ($d = 0.94$, 95% CI = 0.63–1.2)).

Table 3
Variables associated with maintenance of treatment gains (N = 183).

	Treatment gains		P
	Gains maintained (N = 115)	Gains not maintained (N = 70)	
Age	35.8 (9.8)	36.4 (10.5)	0.63
Pain duration	9.6 (5.2)	10.5 (8.9)	0.25
Initial pain severity	5.2 (1.3)	6.2 (1.4)	0.001
Number of pain sites	2.3 (0.9)	2.8 (0.8)	0.001
Pretreatment PCS	18.9 (10.9)	26.2 (10.6)	0.001
Posttreatment PCS	6.6 (6.7)	17.5 (11.1)	0.001
Pretreatment TSK	41.2 (6.1)	43.9 (6.2)	0.003
Posttreatment TSK	35.1 (6.8)	41.5 (6.8)	0.001

Values in parentheses are standard deviations.

3.4. Predictors of failure to maintain treatment gains

A logistic regression was conducted to assess the unique contribution of posttreatment predictors of failure to maintain treatment gains at 1-year follow-up. As shown in **Table 4**, pretreatment pain severity and number of pain sites were entered in the first step of the analysis and contributed significantly to the prediction of failure to maintain treatment gains, $\chi^2 = 25.3$, $P < 0.001$. Pretreatment PCS and TSK scores were entered in the second step of the analysis and contributed significant variance beyond the variance accounted for by pretreatment pain severity and number of pain sites $\chi^2 = 7.9$, $P < 0.001$. Posttreatment PCS and TSK scores were entered in the third step of the analysis and contributed significantly to the prediction of failure to maintain treatment gains, $\chi^2 = 42.2$, $P < 0.001$. In the final regression equation, both the posttreatment PCS (odds ratio [OR] = 1.14; CI = 1.0–1.2) and the TSK (OR = 1.08; CI: 1.0–1.1) made significant unique contributions to the prediction of failure to maintain treatment gains. In other words, participants who obtained high posttreatment scores on measures of catastrophizing and fear were at increased risk of failing to maintain treatment gains. The classification rate for the final regression equation was 77%.

A second logistic regression was conducted where scores on the PCS and TSK were dichotomized according to recommended clinically meaningful cut scores. A similar pattern of findings was obtained. Using dichotomized scores to predict failure to maintain treatment gains, high posttreatment PCS scores were associated with an OR of 12.0 (CI = 3.9–36.6) and high posttreatment TSK scores were associated with an OR of 3.3 (CI = 1.5–7.3).

4. Discussion

The findings of the present study are consistent with previous research showing that treatment gains are not maintained by a substantive proportion of work-injured individuals participating in physical rehabilitation interventions.[10,28] The findings are also consistent with previous research showing that psychosocial risk factors are significant determinants of delayed recovery following musculoskeletal injury.[24,30,41] The results of the present study extend previous research in showing that high posttreatment scores on measures of pain catastrophizing and pain-related fear are associated with increased risk of failing to maintain treatment gains. To our knowledge, this is the first study to show that psychosocial risk factors influence whether treatment gains will be maintained following physical rehabilitation for musculoskeletal pain.

In the present study, response to treatment was dichotomized as *recovered* or *not recovered* on the basis of the magnitude of pretreatment to posttreatment reductions in pain, and the posttreatment pain severity score. Recovery was operationally defined as a reduction in pain of 2 points or more on an 11-point numerical rating scale, and a posttreatment pain score less than 4/10. On the basis of this operational definition, 60% of participants were classified as recovered at the end of treatment. Findings were consistent with previous research showing that poor recovery was associated with higher initial pain scores, longer duration of work disability at the time of admission, and multiple pain sites.[18,23,53,54]

Failure to maintain treatment gains was operationally defined as evidence of clinically significant increase in pain from treatment termination to 1-year follow-up, and pain ratings at 1-year follow-up in the moderate or severe range. On the basis of this definition, 38% of subjects failed to maintain treatment gains at 1-year follow-up. Consistent with predictions, posttreatment scores on the PCS and TSK were significant and independent predictors of failure to maintain treatment gains.

The processes by which catastrophizing and fear of pain influence the probability of maintaining treatment gains are likely similar to the processes by which these psychosocial risk factors contribute to problematic recovery. Pathophysiological and psychological factors have been implicated as the basis for the relation between catastrophizing and adverse pain outcomes. There are indications that pain catastrophizing might interfere with descending pain-inhibitory systems, facilitate neuroplastic changes in the spinal cord, and contribute to pain sensitization in the central nervous system.[15,31] Psychological explanations of the relation between catastrophizing and adverse pain outcomes have addressed the possible roles of exaggerated threat appraisals,[27] negative expectancies,[42] attentional factors,[49] and ineffective coping strategies.[45] The basis for the relation between fear of pain and adverse pain outcomes has been addressed primarily in activity avoidance, maladaptive alterations in motor function, deconditioning, and hypervigilance to pain-related stimuli.

There are important clinical implications to the findings of the present study. If levels of catastrophic thinking and fear of pain remain elevated at the completion of a pain rehabilitation program, there is the risk that treatment gains will not be maintained. The predictive value of posttreatment PCS and TSK scores was examined using scale scores as continuous variables and as dichotomous variables. Both approaches yielded comparable results. The stronger predictive power of the PCS and TSK when dichotomized suggests that previously

Table 4

Predictors of failure to maintain treatment gains (N = 185).

Step	Variables added at each step	Statistical summary						
		$\Delta\chi^2$	Δdf	R^2	−2LL	OR	95% CI	*P*
1	Initial pain	25.3	2	0.17	221.8			0.001
	Pretreatment pain severity (0–10)					1.4	1.2–1.9	0.01
	Number of pain sites					1.5	0.92–2.50	0.10
2	Pretreatment questionnaire scores	7.9	2	0.22	212.4			0.15
	PCS					0.95	0.90–1.0	0.08
	TSK					1.0	0.93–1.0	0.79
3	Posttreatment questionnaire scores	43.2	2	0.46	169.1			0.001
	PCS					1.14	1.0–1.2	0.001
	TSK					1.08	1.0–1.2	0.05

ORs and 95% CIs are adjusted for other variables. −2LL = −2 times the log likelihood. $\Delta\chi^2$ and Δdf are the change in χ^2 and associated degrees of freedom resulting from the addition of predictor variables, and *P* is the statistical significance of the change of the OR for a variable. R^2 is the Nagelkerke (56) R^2. ORs, 95% CIs, and *P* values are from the final regression equation.
OR, odds ratio; CI, confidence interval.

recommended cut scores for the PCS and the TSK could be used as clinical guides for treatment targets and the evaluation of treatment outcomes.

Numerous clinical cohort studies have provided evidence suggesting that participation in rehabilitation interventions is associated with reductions in scores on measures of catastrophizing and fear of pain.[37] Reports of statistically significant reductions in scores on measures of catastrophizing or fear following rehabilitation confer the impression that these pain-related psychosocial risk factors are amenable to change through a wide range of available treatments. The results of the present study invite caution in making such inferences. It is not clear that the reductions in catastrophizing and fear of pain that have been reported in many clinical cohort studies are of sufficient magnitude to influence important clinical outcomes. Emerging research suggests that the magnitude of change in pain-related psychosocial risk factors must exceed a certain threshold to impact in a meaningful way on clinical outcomes such as pain relief, medication reduction, or return to work.[34] The present research further suggests that unless scores on pain-related psychosocial risk factors can be brought below the risk range by the end of treatment, gains made in treatment might not be maintained in the long term. A literature search revealed no study reporting the percentage of participants with posttreatment catastrophizing scores or fear of pain scores falling below the risk range. Such a metric might need to be considered in future research to evaluate the clinical significance of treatment gains.

Although there have been calls for greater attention to the management of catastrophizing and fear of pain in the treatment of persistent pain conditions, the degree to which these calls for action have been answered by the clinical practice community is unclear. While it is now commonplace to incorporate measures of catastrophizing and fear of pain in clinical assessment protocols for patients presenting with pain conditions, what is less clear is whether treatment approaches are tailored in any way to an individuals' psychosocial risk profile when scores on these measures are elevated. In the documented literature, there is little indication that treatment approaches are tailored to psychosocial risk profiles. This would appear to be an area deserving increased attention if the goal is ultimately to increase treatment successes for individuals with persistent pain conditions.

In recent years, risk-targeted activity reintegration programs have emerged as an approach to rehabilitation where treatment is tailored to individuals' psychosocial risk profile.[5,40] What distinguishes these interventions from traditional rehabilitation interventions is the use of techniques specifically designed to target pain-related psychosocial risk factors, matching treatment techniques to psychosocial risk profile, and where the primary treatment focus is on improving function as opposed to symptom management. An important additional objective of risk-targeted interventions is to reduce pain-related psychosocial risk factors. A number of techniques have been discussed as potentially useful in targeting catastrophic thinking and fear of pain.[55] Some of these include education, guided disclosure, thought monitoring, role-relevant activity reintegration, and exposure.[41] Although comparison trials have yet to be conducted, risk-targeted approaches appear to yield reductions in pain-related psychosocial risk factors of greater magnitude than those associated with traditional rehabilitation approaches.

Caution must be exercised in the interpretation of the findings of this study. The study used operational definitions of "recovery" and "failure to maintain treatment gains" based on the magnitude of change in pain scores. Although the definitions used would be considered evidence-based recommendations, using more liberal or conservative criteria would have altered the pattern of findings. Also, pain relief was the criterion on which definitions of "recovery" and "failure to maintain treatment gains" was based. There are other important outcomes of rehabilitation interventions such as functional improvement, reduced medication intake, and return-to-work that were not considered in this study. It is possible that a different set of predictors might have emerged had recovery and relapse definitions been based on other outcome criteria. It is also important to consider that there were differences in treatment protocol across clinics and across clinicians. In rehabilitation interventions, it is not possible to provide a standardized intervention for all individuals receiving treatment. Although all clinicians adhered to the same clinical practice guidelines, differences in treatments offered could have played a role in the magnitude of symptom reduction and the probability of maintaining treatment gains. The CIs around the ORs for dichotomized posttreatment PCS and TSK scores were also large, further inviting caution in the interpretation of the findings. Given that the study was an exploratory secondary analysis of a preexisting data set as opposed to a test of theory-driven hypotheses, confirmation of the reliability of the findings reported in this paper awaits replication in an independent sample.

Despite these limitations, the findings of the present study highlight the importance of reducing scores on pain-related psychosocial risks factors to ensure that treatment gains are maintained. If replicated, the findings would argue for the inclusion of measures of psychosocial risk as part of posttreatment evaluations as an additional indicator of treatment outcome. The proportion of individuals falling below the risk range on pain-related psychosocial risk factors might be an important metric in determining whether treatments will yield meaningful long-term gains. The present findings also argue for the development of intervention programs that are tailored to individuals' risk profile. Emerging research suggests that risk-targeted interventions might yield superior outcomes compared with traditional approaches to rehabilitation.

Conflict of interest statement

M.J.L. Sullivan receives royalties from the sale to the treatment manual associated with one of the intervention programs described in this article. The remaining authors have no conflicts of interest to declare.

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