Predictors of Success of Intervention Programs for Persons with Fibromyalgia

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ABSTRACT. ***Objective.*** To determine which sociodemographic, psychological, and behavioral characteristics of persons with fibromyalgia (FM) will predict a positive response to treatment; and to determine if subjects classified according to the Multidimensional Pain Inventory (MPI) responded differently to the interventions.

Methods. One hundred twenty-eight women with FM underwent baseline testing and were randomized into one of 3 intervention groups or a control group. After the 12 week program, the subjects were reexamined on the same pretest measures. Stepwise regression analyses were conducted to determine the variables that could significantly predict the change in the dependent variables. A reliability of change index was calculated to determine the proportion of responders and nonresponders.

Results. The stepwise regression revealed significant predictor variables for change for all dependent variables except the Fibromyalgia Impact Questionnaire; however, the percentage of the variance in the change scores explained by the independent variables ranged from 4 to 15%. Results from the reliability of change index indicated that no MPI subgroup responded more than another group on any measure.

Conclusion. Select sociodemographic and psychosocial variables and type of intervention were not strong predictors of improvement in a variety of measures after a treatment program. The low percentage of explained variance may be due to the heterogeneity of FM. Additionally, the low percentage of responders suggests that current forms of treatment are not effective for a large portion of the FM population. (J Rheumatol 2002;29:1034–40)

Key Indexing Terms:
MULTIDIMENSIONAL PAIN INVENTORY SELF-EFFICACY
FEAR-AVOIDANCE BELIEFS DISABILITY QUALITY OF LIFE

Fibromyalgia (FM) is a difficult condition to manage. Moreover, in the current healthcare environment, treatment resources are slim. Research has determined the heterogeneous nature of FM using a multidimensional tool, the Multidimensional Pain Inventory (MPI)[1]. The subgroups that were identified responded differently to the same treatment program, suggesting that one standard program may not effectively manage the condition[2]. Unfortunately, no analysis was done to identify sociodemographic or other psychosocial variables that may have predicted improvements secondary to treatment. Research from the arthritis, low back, and chronic pain fields has identified sociodemographic, psychological, and emotional response variables as potential predictors of success with intervention programs[3–7]. If similar characteristics could predict treatment response in persons with FM, clinicians could optimize the use of available treatment resources.

Sociodemographic variables such as age, years of education, and income have been reported to influence clinical outcome or presentation of pain in chronic pain and arthritis populations[3,4,8]. Being older, less educated, and having lower income negatively affects pain. Lower education has been associated with higher mortality in rheumatoid arthritis (RA)[9] and with the development of FM[10]. Research has shown that employment status and economic rewards (litigation and compensation) were important factors in emotional distress, depression, and illness behaviors, such as inactivity, work and domestic disability in persons with chronic pain[11]. However, Klapow, *et al*[4] reported that sociodemographic variables alone were less accurate than psychosocial variables (52% vs 63% accuracy) at discriminating 3 different pain subgroups in persons with chronic back pain.

Subjects' beliefs or emotional responses to pain and others' response to them may affect treatment success. In low back pain, the emotional response to pain has been

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examined by evaluating fear-avoidance beliefs[12]. According to the Fear-Avoidance Model[12,13], a strong fear of pain results in the avoidance of activities the person feels will exacerbate his/her pain. At the other end of the continuum, pain still exists, but the person is less afraid that activity will increase pain, so he/she still participates in activities. Research has shown that the expected increase in pain with activity, rather than the actual pain experienced, was a significant predictor of poor performance on behavioral tasks[14]. Avoidance behaviors were also a risk factor for the development and maintenance of chronic low back pain[14,15].

Perhaps other determinants of treatment success may be identified by examining responders to treatment in the subgroups of persons with FM. The MPI has classified the majority of persons with FM into categories based upon their perception of the impact of the condition, others' response to them, and their activity level[1]. Turk, *et al*[16] compared the 3 main subgroups of the MPI for the number of treatment responders as determined by the Reliability of Change Index (RC) (which determines the proportion of responders/nonresponders to treatment)[17]. They determined that about 40% of the subjects responded to the standard treatment on a measure of pain severity[16]. Unfortunately, it was not determined if subjects responded to the treatment on measures of disability, coping, or general life satisfaction. It is also unknown if the subgroups of subjects respond differently to different types of interventions. Would a greater proportion of subjects from one subgroup respond more than another subgroup regardless of the intervention?

The purposes of this study were 2-fold. The first objective was to determine which sociodemographic, psychological, and behavioral characteristics of persons with FM will predict a positive response to treatment on measures of disability, life satisfaction, self-efficacy, fitness, number of tender points, and pain severity. The second objective was to identify the proportion of responders/nonresponders for each MPI subgroup in order to determine if they responded differently to the interventions, as measured by various outcomes. It was hypothesized that a positive response to treatment would be identified in persons with FM with the following characteristics: (1) sociodemographics: younger, married, shorter duration of symptoms, higher education, employed, not undergoing litigation or receiving compensation; and (2) psychosocial: lower fear-avoidance beliefs, levels of pain, life interference, and emotional distress; higher activity levels; and perceived ability to function and cope with pain and other symptoms.

MATERIALS AND METHODS

Subjects. One hundred seventy-four women with FM underwent baseline testing. Subjects were referred from rheumatologists or general practitioners (n = 99) or self-referred from the community (n = 75). All subjects were diagnosed with FM according to the American College of Rheumatology 1990 criteria[18]. A rheumatologist involved with the study examined any subject not initially diagnosed with FM by a rheumatologist. Inclusion criteria were: women between the ages of 18 and 65 years with a willingness to meet 1–3 times per week for a 12 week period. Exclusion criteria included any systemic inflammatory disease, such as RA or systemic lupus, any condition precluding the ability to exercise (i.e., severe osteoarthritis or cardiac condition). The study requirements were explained to all subjects. In addition, all subjects read and signed a consent form. The University of Alberta Faculty of Rehabilitation Medicine Ethics Committee approved the procedures undertaken in this study.

Design and data collection. The general design was a prospective cohort design. Subjects completed a physical examination, all questionnaires, and the walking test at an initial visit. Upon completion, they were randomized into one of 3 interventions (exercise only, education only, or combination of exercise and education) or a control group. After the 12 week program, subjects were reexamined on the same measures as at pretest.

The exercise component involved aerobic exercise 3 times per week for the 12 week period. The duration of exercise at the beginning of the program was 10–15 min depending upon the physical condition of the subject and was gradually increased to 25–30 min per session. The intensity of exercise started at 50% age predicted heart rate maximum and ranged from 55 to 70% age predicted heart rate maximum by the end of the program. Heart rate was monitored with a remote wireless heart rate monitor (Polar Accurex HRM, WA, USA) at each session. Although the duration and intensity guidelines were typically followed, the exercise program was individualized for each subject and slight alterations may have occurred to account for physical conditioning differences in the group. The activities included walking, low impact aerobics, water aerobics (deep and shallow), and stationary cycling. A warmup, cooldown, and stretching period was included in each session. Toning or light strengthening exercises were also included after the first few sessions. Each session was led by a certified fitness leader with basic knowledge about FM. A physical therapist experienced in working with patients with FM supervised every session. The therapist assisted the subjects with adjusting their duration and intensity of exercise and with modifying the activities when necessary.

The education group met once or twice per week for 1.5 h. A person experienced in leading small patient education groups facilitated each session. The sessions were very interactive and the subjects were expected to be actively involved in sharing information and finding solutions to different concerns people may have had. Sessions included information about what is currently known about FM, pain and fatigue management strategies, how to start or rejuvenate an exercise program, identifying and removing barriers to activities, a question and answer period with a rheumatologist; a registered dietician discussed reading food labels and basic good nutrition, and a psychologist met with the group to discuss a variety of issues dealing with topics such as grief and pain. Another session included the family and/or friends of study participants. It was designed mainly for the family members to learn more about FM and how they could assist someone with the condition.

The combined exercise and education group had exercise twice a week and exercise and education one time per week. The control group was contacted by telephone twice during the 12 weeks, but did not receiving any formal instruction. The control group was instructed to continue with their regular exercise program if they had one established, but to not begin exercising if they were not already.

Independent variables. The independent variables (16 variables) collected were the following: (1) Age measured in years. (2) Duration of symptoms — measured in months from when first experienced symptoms. (3) Marital status — divided into categories: single, married/common-law, and divorced/separated. The variables were divided into 2 dichotomies or dummy variables (one less the number of categories). One variable was married/common-law versus other, and the second was divorced/separated versus other. The dummy variables were coded as 1 = yes, 0 = no. (4) Employment status — coded as 1 = yes, 0 = no. Part-time work was considered as employed. (5) Level of education — original data were categorized as: less than high school (no high school diploma), high school (have diploma), and more than high school (some college/university). The cate-

gories were divided into 2 dummy variables. One variable was less than high school versus other, and the second was greater than high school versus other. The dummy variables were coded 1 = yes, 0 = no. (6) Receiving compensation — coded 1 = yes, 0 = no. (7) Undergoing litigation — coded 1 = yes, 0 = no. (8) Intervention — subjects were randomized into one of 4 groups (3 interventions, one control group). Two categories were created: exercise versus no exercise, and education versus no education. Categories coded 1 = yes, 0 = no. (9) West Haven-Yale Multidimensional Pain Inventory (MPI)[19] — questionnaire that classifies subjects according to their response to pain, response of significant others to them, and their general activity level. Subjects were classified into one of 6 categories: Adaptive Coper (AC), Interpersonally Distressed (ID), Dysfunctional (Dys), Unanalyzable, Hybrid, or Anomalous. The last 3 categories were combined and called Other. Lower levels of pain, life interference, and emotional distress and higher levels of activity characterize the AC. Subjects classified as Dys are the opposite of the AC on all scales. The variables used were AC vs other and Dys vs other. They were coded as 1 = yes, 0 = no. (10) Fear-Avoidance Beliefs Questionnaire (FAB)[20] — examines patients' beliefs about avoidance of behaviors due to a fear of increasing pain levels. Two subscales, physical activity and work, are delineated in the questionnaire. The subscales are continuous variables. A higher score indicates greater fear-avoidance beliefs. (11) Chronic Pain Self-Efficacy total score (SE)[21] — a 20 item scale of 3 subscales (pain coping, functioning, and coping with other symptoms). The scales measure subjects' beliefs in their ability to perform specific tasks and control symptoms of their condition. By adding the subscales together, an SE total score is obtained. A higher score indicates greater self-efficacy. It is a continuous variable. It was entered into the regression analyses for all dependent variables.

All independent variables were recorded as the subject's status at the time of entry to the study and not previous status. For instance, if she had received compensation for a period of time, but currently was receiving none, she would be coded as no.

Dependent variables. Dependent variables included in the analysis were a change in: (1) Fibromyalgia Impact Questionnaire (FIQ) — a 19 item survey measuring physical functioning, work status, depression, anxiety, sleep, pain, stiffness, fatigue, and well being in persons with FM[22]. The total FIQ score was calculated according to Burckhardt, *et al*[22]. The range of scores is 0–80, a higher score indicating greater impact of the condition on the person's life. The reliability of the FIQ has ranged from 0.56 to 0.95[22]. (2) Quality of Life Questionnaire (QOL) — a 16 item questionnaire dealing with satisfaction with various aspects of life, such as health/physical activity, raising or having children, independence, learning or attending school[23]. Each item is rated on a Likert scale ranging from 1 (terrible) to 7 (delighted). A total satisfaction score is obtained by summing all 16 items, with total scores ranging from 16 to 112. A higher score indicates greater satisfaction with life. The test-retest reliability of the QOL measure has ranged from 0.76 to 0.84[23]. (3) Self-Efficacy-pain coping (SE-pain) — a subscale from the SE total score. Examines perceived ability to cope with pain. The test-retest reliability of this subscale has been reported to be 0.88[21]. (4) Self-Efficacy-function (SE-function) — subscale from the SE total score. Examines perceived ability to perform certain functional activities. The test-retest reliability of this subscale has been reported to be 0.87[21]. (5) Self-Efficacy-coping with other symptoms (SE-cope) — subscale from the SE total score. Examines perceived ability to cope with other symptoms of chronic pain. Test-retest reliability of this subscale has been reported to be 0.90[21]. (6) Six Minute Walk (6MW) — a field test developed from Cooper's 12 minute walk/run[24]. Subjects walked along a level 40 m corridor and were instructed to "cover as much ground as possible in 6 minutes." Encouragement such as "good pace, keep it up" or "good work" was given at 2, 3, 4, and 5 minutes. At these same time intervals, the subjects were informed of the time remaining in the walk. Encouragement and time remaining were standardized for all patients. The distance covered was measured in meters. The 6MW has been used in FM research to evaluate fitness[25-27]. The reliability of the walk ranges from 0.73 to 0.89[28]. (7) Number of Tender Points (TP) — the 18 TP were examined according to an established manual TP survey protocol[29]. This protocol outlines examiner and subject positioning, order of examination, and pressure application technique. The total number of painful TP was the TP count (range 0–18). (8) Pain Severity at Tender Points — used as a self-report measure of pain severity[29]. Each time a TP was palpated, the subject rated the pain severity as 0 (no pain) to 10 (worst pain). The pain severity ratings ≥ 2 were considered positive TP. The scores for these positive TP were totalled, providing a Total Survey Site score (range 0–180).

The dependent variables were selected because they were reliable measures that had been previously utilized with persons with FM.

Statistical analysis. Continuous variables were summarized by means and standard deviations. Categorical data were summarized by frequencies. Change scores were calculated from measures taken before and immediately after an intervention. The post-score was subtracted from the pre-score for all variables except the FIQ, Number of TP, and Total Survey Site Score, where a lower post-score indicated an improvement in that measure. The pre-score was subtracted from the post-score for these variables. A higher, positive change score indicated greater improvement in that variable at the end of the 12 weeks.

Pearson Product Moment correlations were calculated to determine significant relationships between the independent and dependent variables. Step-wise regression analysis was performed using SPSS version 8.0 and the default criteria (significance of $p < 0.05$ and $p > 0.1$ for removal). To determine the proportion of responders/nonresponders for the subjects classified according to the MPI, a reliability of change (RC) index was calculated[17] for each subject with each measure. A responder is a person with RC index > 1.96. This indicates that the magnitude of the change can be considered more than that which occurs with the normal measurement fluctuations from repeated measures. An RC index < 1.96 indicates a nonresponder. A negative RC index indicates a decline in scores or a worsening of the score. This index is determined by the following equation:

$$RC = \frac{x_2 - x_1}{s_1\sqrt{1 - r_{xx}}},$$

where x_1 is the subject's pre-test score, x_2 is the subject's post-test score, s_1 is the standard deviation of the pre-scores, and r_{xx} is the test-retest reliability of the measure. The test-retest reliability scores (r_{xx}) used to calculate each RC index were as follows: FIQ 0.56[22], QOL 0.76[23], SE-pain coping 0.88, SE function 0.87, SE-coping with symptoms 0.90[21], and 6MW 0.73[28]. Kruskal-Wallis tests (nonparametric) were used to determine if significant differences existed among the MPI groups and number of responders for each variable.

RESULTS

Of 174 subjects recruited at baseline, 128 returned for post-testing and were included in the analyses. Reasons for not continuing with the study program included lack of time, family health/personal problems, felt program would not help, or they could not be reached or refused to return for testing. Four subjects did not continue with the program, but did return for the post-testing. They were included in the analyses. Table 1 gives demographic information only for the subjects included in the analyses. A one-way analysis of variance for the continuous variables and chi-squared analysis were used to determine if any significant differences were present between the dropouts and completers on all the baseline measures. The only significant difference between the dropouts and completers was education level ($p = 0.029$). Subjects with higher education levels (some

college or university education) were more likely to drop out than subjects with high school or less education.

The data were examined to check the assumptions of linear regression. Violations to the assumptions were not revealed, therefore transformations of the data were not necessary. Change scores for the dependent variables are presented in Table 2. The significant relationships from the Pearson Product Moment correlations between the independent and dependent variables are presented in Table 3. Due to lack of significant correlations with any of the dependent variables, age, employment status, compensation, and litigation were removed from the list of independent variables for the stepwise regression. This increased the ratio of cases to independent variables, thereby improving the power.

Results from the stepwise regression analyses revealed significant predictor variables for change for all dependent variables except the FIQ (Table 4). The percentages of the variance in the change scores explained by the independent variables ranged from 4 to 15%. The predictor that appeared most often in the regression results was duration of symptoms. It predicted a change in SE-function, 6MW, and Total Survey Site Score. In Table 4, the negative beta weights indicate a decrease in the change or a negative change in dependent variable, whereas positive beta weights indicate an increase in the change in dependent variable.

Responders/nonresponders. Table 5 outlines the responders to an intervention program in subjects grouped according to the MPI. The 128 subjects that completed pre- and post-testing were classified into one of the 4 MPI categories. Of the subjects that dropped out, there was a fairly equal distribution among the MPI subgroups (AC = 9, ID = 16, Dys = 10, and Other = 14). Nonparametric tests indicated that no group responded more than another group on any measure.

Table 1. Demographic variables for the cohort (n = 128).

Variable	Mean ± SD* (range)
Age, yrs	46.8 ± 8.7 (18–64)
Height, cm	162.0 ± 6.1 (144–177)
Weight, kg	77.9 ± 18.4 (45–142)
Duration of symptoms, yrs	9.2 ± 8.0 (4–40)
Onset of symptoms, %	
Idiopathic	73.4 (n = 94)
Traumatic	26.6 (n = 34)
Marital status, %	
Single	15.6 (n = 20)
Married/common-law	69.5 (n = 89)
Divorced	14.8 (n = 19)
Education, %	
< High school	16.4 (n = 21)
High school diploma	29.7 (n = 38)
College/university	53.9 (n = 69)
Employed (full and part–time), % yes	43.8 (n = 56)
Litigation, % yes	9.3 (n = 12)
Compensation, % yes	32.0 (n = 41)
Number of TP	16.5 ± 1.8 (11–18)
Pain severity at TP 0–180	103.0 ± 32.8 (2–176)

* Mean ± SD unless stated otherwise. TP: tender points.

Table 2. Mean change scores for each dependent variable used in regression analysis. Positive value indicates an improvement.

	Mean Change Score (SD)	Range of Change Scores
FIQ	4.3 (12.5)	–25.3–42.2
QOL	2.0 (11.1)	–23.0–46.0
SE-pain	5.1 (19.2)	–38.0–60.0
SE-function	3.4 (16.4)	–64.4–78.9
SE-symptoms	5.9 (18.6)	–48.3–56.7
6MW, M	16.5 (66.2)	–134.0–209.0
Number of TP	0.80 (2.4)	–9.0–5.0
Total Survey Site score	4.3 (33.0)	–91.0–97.0

FIQ: Fibromyalgia Impact Questionnaire, QOL: Quality of Life Scale, SE: Self-Efficacy, 6MW: Six Minute Walk, TP: tender points.

DISCUSSION

The results indicated that select sociodemographic and psychosocial variables and type of intervention were significant, but not strong predictors of improvement in a variety of measures after a treatment program. The main independent variables that predicted a positive change in dependent variables were a higher education, longer duration of symptoms, lower perceived abilities to cope and function with FM, and MPI classification other than Dys. Additionally, when the MPI subgroups were examined, no single group demonstrated a greater proportion of responders/nonresponders compared to another group.

Despite the identification of significant independent variables, they were not strong predictors of change in the measures employed. Indeed, the best predictive model only explained 15% of the variance in the change of SE-coping with pain (Table 4). The other independent variables explained less than 13% of the variance in the change score of the dependent variables. The low percentage of explained variance in the change scores suggests that either the heterogeneous nature of FM precludes the identification of predictor variables and/or the independent variables selected were not appropriate predictors of treatment success.

Other constructs or combination of variables may be better predictors of change after treatment and have not been identified in persons with FM. In an FM population, type of coping style (catastrophizer) was able to explain a significant amount of variance in psychosocial disability scores, controlling for demographic and clinical variables and disease severity[30]. McCracken reported that greater acceptance of chronic pain was associated with lower pain intensity, less pain related anxiety and avoidance, and less depression in a chronic pain population[31]. Social support has emerged as an important factor in the management of chronic pain conditions[4], and would perhaps be crucial in the management of FM. Other demographic, psychosocial,

Table 3. Significant results from the Pearson Product Moment correlations between the independent and dependent variables. Data in parentheses are p values.

Dependent Variables	Significant Independent Variables		
FIQ*	No significant independent variables		
QOL	Less than high school (0.008)	Greater than high school (0.024)	
SE–coping with pain	Self–efficacy total score (0.007)	Married/common-law (0.043)	
SE–function	Duration of symptoms (0.030)	Self–efficacy total score (0.049)	
SE–coping with symptoms	Self–efficacy total score (0.011)		
6MW	Dysfunctional (0.003)	Exercise group (0.011)	Fear–Avoidance, physical activity (0.035)
Number of TP	Greater than high school (0.054)		
Pain severity at TP	Duration of symptoms (0.029)	Adaptive coper (0.045)	

*Dependent variables are all change scores. Significant at $p < 0.05$ level.

Table 4. Results of stepwise regression analysis used to predict change in the dependent variables.

Dependent Variables	Independent Variable	Multiple R	R^2	Adjusted R^2	β	Sig	SEE
Quality of life	1. < High school	0.215	0.046	0.044	–0.227	0.016	11.00
SE-coping with pain	1. SES Total	0.233	0.054	0.045	–0.233	0.009	18.77
	2. Dys	0.342	0.117	0.112	–0.300	0.001	18.21
	3. FAB–phys activity	0.391	0.153	0.137	–0.177	0.000	17.91
SE–function	1. Dur symp	0.200	0.040	0.028	0.187	0.025	16.17
SE–coping with other symptoms	1. SES total	0.214	0.046	0.042	–0.221	0.016	18.25
	2. > High school	0.288	0.083	0.074	0.204	0.005	17.97
Six Minute Walk	1. Dys	0.253	0.064	0.059	–0.257	0.005	65.87
	2. Exerc grp	0.308	0.095	0.088	0.191	0.002	65.04
	3. Dur symp	0.355	0.126	0.111	0.174	0.001	64.18
Number of TP	1. > High school	0.210	0.044	0.033	0.203	0.028	2.29
Pain severity at TP	1. Dur symp	0.228	0.052	0.043	–0.227	0.017	30.53

Dys: Dysfunctional, FAB-phys activity: fear avoidance beliefs-physical activity, SES: Self-efficacy scale, TP: tender points, Dur symp: duration of symptoms, Exerc grp: exercise group, Sig: significance, SEE: standard error of the estimate.

Table 5. The number of responders versus nonresponders in subjects classified according to Multidimensional Pain Inventory.

	AC*, n = 39	ID, n = 35	Dys, n = 25	Other, n = 28	Total Group
	Number of Responders (% responded)				
FIQ	6 (15.4)	7 (20.0)	5 (20.0)	7 (25.0)	25 (18.7)
QOL	4 (10.3)	2 (5.7)	5 (20.0)	5 (17.9)	16 (11.9)
SE–pain	9 (23.1)	11 (31.4)	6 (24.0)	11 (39.3)	37 (27.6)
SE–function	7 (17.9)	7 (20.0)	7 (28.0)	11 (39.3)	32 (23.9)
SE–coping	13 (33.3)	16 (45.7)	10 (40.0)	10 (35.7)	49 (36.6)
6MW	2 (5.1)	8 (22.9)	0 (0.0)	6 (21.4)	16 (12.1)

* For the 6MW group sizes are : AC n = 39, ID n = 37, Dys n = 28, Other n = 28. AC: adaptive coper, ID: interpersonally distressed, Dys: dysfunctional, FIQ: Fibromyalgia Impact Questionnaire, QOL: Quality of Life Scale, SE: Self–efficacy Scale, 6MW: Six Minute Walk test.

or psychological variables may be more important than the variables utilized in this study for predicting success from a treatment program in persons with FM. Although previous studies did not predict changes after treatment, they did identify variables that could potentially be investigated as contributing to changes after treatment.

Despite the identification of sociodemographic, psychological, and emotional response variables as predictors of success with intervention programs in persons with arthritis and low back and chronic pain, the same was not true with this FM cohort. One could speculate that the role of central physiological mechanisms in FM contributes to the lack of strong sociodemographic and psychological variables. In our study, the majority of independent variables were sociodemographic. Perhaps if central factors had been measured and used as independent variables, stronger relationships could have been identified.

It should be emphasized that this study was exploratory, and by no means exhausted or identified all possible predictor variables. The purpose was to begin to identify potential sociodemographic or psychosocial variables as predictors of treatment success. Certain relationships should be examined in greater depth to fully determine their influence upon persons with FM. For example, employment status, compensation, and litigation did not reveal significant correlations with any dependent variable. These variables have been identified as important factors in emotional distress, depression, and illness behaviors in persons with chronic pain[32]. Further, these relationships may not be direct, but rather are mediated by other factors such as job satisfaction or financial strain[32,33]. Perhaps because the employment, compensation, and litigation variables were dichotomous, the relationship with the change in dependent measures was not captured. A direct relationship between these independent variables and the dependent variables may not have been revealed due to other factors such as job satisfaction, social contact at work, amount of control in the workplace, and financial strain mediating the relationship. Although the relationships may not be the same in FM as in chronic pain, the complex interactions of variables such as employment, compensation, and litigation may need to be examined further.

The percentage of responders for the MPI subgroups combined and individually was also very low. When total subject response was examined for all the variables, only 12–37% of the subjects responded after the 12 weeks. Turk, *et al*[16] examined the number of responders on a measure of pain severity and reported that 39.3%, 22 of their 56 subjects, responded after an intervention. Vlaeyen, *et al*[34] also reported low percentages of responders in 2 treatment groups (6.4 and 18.4%) in persons with FM. The absence of clinically significant changes would suggest that the subjects did not respond regardless of the intervention they received. The low percentages of responders from previous research and from the current study suggest that there is still a large portion of the FM population that does not benefit from the treatment programs currently offered.

The highest percentages of responders for all groups combined were determined with the self-efficacy subscales. This finding indicates that perhaps the self-efficacy scale was a very sensitive measure. It also may indicate that persons with FM perceive themselves to be coping better, but this is not translated into improved function or reduced disability. Perhaps self-management programs designed to enhance self-efficacy in this population do not provide the necessary skills to actually enhance functioning and overall well being. Factors related to their environment (social and work) may influence their behavior to the extent that certain programs do not alter behaviors.

A limitation of this study was the measure of success that was utilized. A change score (post-/pre-test difference) was used to define improvement after an intervention, where a larger positive difference indicated greater improvement from the intervention. As highlighted by Cronbach and Furby[35], the use of a raw score to evaluate or measure change after an intervention has its problems. One concern with the use of a change score is the potential for regression towards the mean on post-test. In an attempt to minimize the effect of regression to the mean, we used only reliable measures that had been used with persons with FM previously. Cronbach and Furby[35] offer alternatives to using a change score in evaluating treatment programs, and in future research their suggestions should be examined.

Another limitation was that the level of depression was not measured in depth, nor used as an independent variable. Although rates of depression vary widely in persons with FM[36], Turk, *et al*[16] reported that depression was a factor discriminating between responders and nonresponders to treatment. In our study, level of depression may have been identified as a variable predicting the change in one or more of the dependent variables. Future research should include a reliable measure of depression to clarify its role in the management of FM.

Our results indicate that higher education, longer duration of symptoms, lower fear-avoidance beliefs for physical activity, lower self-efficacy beliefs, and classification other than Dys were the main predictors of treatment success after a 12 week intervention. However, these variables were able to explain only a small portion of the variance, indicating that more important predictors may exist. The low percentage of explained variance with the change scores may also be due to the heterogeneity of FM. In addition, the poor percentage of responders suggests that current forms of treatment are not effective for a large portion of the FM population. Therefore, health care professionals must be cognizant of the heterogeneity of persons with FM and continue to individualize its management.

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