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Psychosocial Factors and Functional Capacity Evaluation Among Persons With Chronic Pain

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Psychosocial factors have been found to have a significant impact on functional activity, particularly among persons with chronic pain. While various systems have been developed to assess functional limitations through functional capacity evaluation (FCE), assessment of psychosocial factors that may impact function have been largely ignored. This paper examines the existing literature on psychosocial factors and FCE performance. Given that there are few studies that have directly addressed this issue, the paper also examines psychosocial factors that have been found to influence function in persons with pain. The results of the literature review indicate that few psychosocial factors have been found to be directly associated with FCE and functional measures, although many are related to various measures of disability. The strongest evidence that psychosocial factors are related to functional performance is based on the studies examining the association between functional activity and pain-related fear, self-efficacy, and illness behavior. Psychosocial factors have also been shown to influence measures of sincerity of effort often obtained during FCE. Proposals for modifying FCE assessment are given based on the available data, as well as suggestions for future research.

KEY WORDS: chronic pain; functional capacity evaluation; disability; psychosocial factors.

INTRODUCTION

Many authors advocate for functional assessment of persons with medical impairment and associated disability to assist in determining whether a person is disabled from vocational activity, and/or whether work activities should be restricted (1,2). Various systems of functional assessment have been developed, and are often referred to as functional capacity evaluation (FCE). FCE is defined as a systematic, comprehensive, and objective

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measurement of a person's maximum work ability (1). Many of the assessment techniques employed for FCE have been developed in the fields of occupational therapy, physical therapy, ergonomics, and sport medicine. In the application of these techniques to various populations of injured persons, there has been little study of how factors unique to these groups influence the validity and results of FCE testing. Several measures have been developed to examine the sincerity and level of effort during FCE testing, but research suggests that some of these measures lack sensitivity, specificity, and validity in certain populations. In addition, these measures appear to be influenced by numerous factors, and therefore do not appear to be useful in identifying specific factors that may influence FCE findings.

Research is just beginning to examine the impact of psychosocial factors on FCE. Given the predominant role of psychosocial factors on the experience of chronic pain and associated disability (3,4), more research is needed to explore how psychosocial factors influence the validity and outcome of FCE testing in this population. The purpose of this study was to examine the impact of psychosocial factors on FCE assessment among persons with chronic pain. Given that there is little research in this area, the paper will also highlight psychosocial factors related to other measures of disability in persons with chronic pain. Following a summary of the findings, suggestions for future research and alterations to FCE assessment are presented.

To identify factors that may be directly related to FCE, we wished to make a distinction in the review between studies examining self-report of function, and those that examined objective or observable measures of function, as presumably studies utilizing the latter methodology have greater generalizability to FCE.

While few studies have systematically examined the influence of psychosocial factors on functional assessment among persons with chronic pain, the importance of these factors is illustrated in a recent study by Rudy *et al.* (5). These authors examined physical functioning among 31 persons with chronic pain secondary to paraplegia or lower limb amputation and 31 normal, healthy persons. The authors examined performance on measures of maximal isometric lift strength and isodynamic reciprocal push–pull. The authors found that persons with pain stopped each task after fewer repetitions compared to controls. In testing a psychosocial model of physical performance, the authors found that 90% of the variance in physical performance could be accounted for by psychosocial factors. Perceived self-efficacy of ability to perform the task, perceived emotional and physical functioning, pain intensity, and pain cognitions displayed the highest associations with physical performance.

While psychosocial influences on function are believed to be stronger in persons with chronic pain, the reader should be aware that many of the factors discussed in this paper may be also be present among persons with acute health problems. In fact, their presence may serve as a risk factor for chronicity. For example, Klenerman *et al.* (6) reported that a measure of pain-related fear and activity avoidance correctly classified 66% of persons who went on to develop chronic back pain. A recent study by Fritz *et al.* (7) further highlights the potential importance of pain-related fear on disability and function among persons with acute pain. The authors examined the influence of pain-related fear, pain intensity, physical impairment and disability on current function, and treatment outcome after 4 weeks of physical therapy among persons with acute low back pain. Fear-avoidance beliefs about pain were found to be significant predictors of increased disability and inability to work due to pain even when controlling for initial physical impairment, pain intensity, disability, and type of therapy received. The authors concluded that pain-related fear appears to play

a significant role in the experience of acute back pain, consistent with studies conducted among persons with chronic pain.

METHODS

English-language articles were identified through a search of the MEDLINE database from 1966 to the present. Key words used to retrieve the literature were chronic pain, functional capacity evaluation, disability, and psychosocial factors. The bibliographies of the retrieved articles were then searched for additional publications. Standardized or structured analysis of the identified papers was not possible because of variation in quality, design, and methods and because of the breadth of the articles included. Articles were, therefore, selected when dealing with "functioning" or "disability" and not just "FCE." Emphasis was given to empirical studies that used more rigorous diagnostic methods, larger samples, systematic analyses, appropriate comparison groups, and longitudinal follow-up. When available and relevant, the strength of the relationships were retrieved and presented in this paper.

PAIN

The presence of pain, particularly chronic pain, presents a unique challenge for FCE testing. One assumption made during FCE testing is that performance is reflective of a persons' true physical capacity. However, in pain populations, pain, and not physical factors, is often reported to be the cause of functional limitations. This calls into question whether FCE measures validly reflect physiologic capacity in this population, or whether FCE performance is more reflective of other factors such as pain. Studies examining the validity of functional measures in chronic pain populations have shown that these measures lack validity in a large proportion of patients. For example, one study found no association between walking distance on a 6-min walk test and peak VO2 among persons with fibromyalgia (8). In another study, the performance of normal, healthy persons was compared to those with low back pain on the Sorensen endurance test (9). Pain, rather than fatigue, was the primary reason for stopping performance on this task among persons with back pain, leading the authors to conclude that this test in back pain populations was more reflective of pain rather back muscle endurance. Finally, another study examined the relationship between perceived effort and function among persons with chronic back pain (10). While perceived exertion and physiologic effort are highly related in normal, healthy individuals, the authors found no relationship between perceived effort and physiologic effort or aerobic capacity in this population utilizing cycle ergometer testing.

While one might argue that FCE measures in these cases are reflective of physical capacity regardless of whether persons are limited by pain or endurance, it is questionable whether pain resulting from physical impairment is the cause for disability among persons with chronic pain. First, it is difficult to assess the validity of pain complaints as pain is a private experience. Second, studies suggest that there is little relationship between underlying pathophysiology and the experience of chronic pain (11,12). Third, pain is viewed as being a multidimensional phenomenon that is influenced by many factors, such

as effect, previous experience, and cultural beliefs, in addition to sensory input (13). Given that models of chronic pain emphasizing strict physiological causes have not been supported in the literature (14), a more contemporary model, the biopsychosocial model of pain, is increasingly gaining empirical support and acceptance. In this model, both physical and psychological factors, to varying degrees, are believed to both contribute to the experience of pain. Psychosocial factors deemed to be important in the experience of pain include cognitions (thoughts, beliefs, and appraisals), coping responses, and social environment variables (15).

Thus, complaints of pain during functional activity are not solely reflective of tissue damage or sensory input. In addition, research suggests that factors other than pain might be more highly related to functional limitations among persons with chronic pain. A number of studies have reported little or no relationship between clinical pain intensity and disability (16–20), particularly when the influence of psychosocial factors is examined simultaneously. Studies investigating the relationship between pain and functional activity have found that anticipated pain, rather than actual pain experienced during activity, is more highly related to functional performance. For example, one study examined the relationship between pain, anticipated pain, fear of (re)injury, and peak torque during flexion and extension of the knee among persons with back pain (21). The authors found that high pain expectancy was associated with lower peak torque of the knee flexors, and marginally associated with higher pain related fear. In a similar study, the authors found that ratings of how much pain an activity might cause, in this case, isometric lumbar strength, and a measure of pain-related fear were significantly associated with this measure of strength (22). Actual pain during the testing, and beliefs about disability, were not significantly related to strength. These results suggest that anticipation of pain appears to be more highly related to functional performance than actual pain experienced during activity. These findings lend support to fear-avoidance models of pain and disability, which are discussed further below.

ANXIETY/PAIN-RELATED FEAR

Pain-related fear (beliefs that pain is a sign of damage or harm to the body, and that activities that might cause pain should be avoided) is believed to be an important contributor to disability and adjustment among persons with chronic pain. Pain-related fear may influence pain and disability in several ways. One mechanism involves the avoidance of feared situations, as persons who experience a high level of pain-related fear over time begin to avoid situations that they believe may cause pain (23–26). These persons also tend to overestimate the amount of pain experienced during functional activity (21,27), leading to a higher level of activity avoidance. In this fashion, pain-related fear and associated avoidance of activity over time are believed to contribute to disability independent of pain itself. Pain-related fear and avoidance have also been proposed to lead to greater physical deconditioning, which in turn heightens disability (28). Pain-related fear has been shown to be associated with musculoskeletal abnormalities such as muscle guarding and restricted movement while bending, which in turn may directly contribute to the pain experience (29,30).

Several studies support the notion that pain-related fear is significantly related to greater perceived disability, even when controlling for biomedical factors, demographic variables, and self-reported pain (20,31,32). Two studies (33,34) have demonstrated that

pain-related fear among persons with chronic pain is associated with a profile of high psychological distress, high interference due to pain, low perceived control over pain, and low activity levels on the Multidimensional Pain Inventory (35). Studies have also reported that decreases in pain-related fear during treatment are associated with improved physical functioning, decreased depression and pain severity, and lower interference due to pain (36,37).

Studies examining the influence of pain-related fear on functional performance are consistent with the findings of studies that have utilized measures of perceived disability. Vlaeyen *et al*. (38) found that pain-related fear was inversely related to the amount of time a person with back pain was willing to hold a heavy bag until pain or physical discomfort made it impossible to continue. One study found that higher peak torque on tasks of isokinetic trunk extension and flexion was associated with lower pain-related fear (28). Similar findings were obtained on measures of knee extension and flexion, as well as trunk rotation. Another study found that beliefs that activities that cause pain should be avoided were significantly related to poorer performance on a lifting task even when controlling for factors such as clinical pain, physiologic and perceived effort, and body mass index (17).

In a recent study, changes in pain-related fear were examined in relation to changes in functional activity among 65 persons with chronic pain enrolled in a multidisciplinary treatment program (39). The authors found that decreases in pain-related fear were significantly associated with increased lifting and carrying pre- to posttreatment even when controlling for changes in pain, pain duration, age, and gender.

In summary, pain-related fear appears to be significantly associated with functional performance independent of pain intensity and other biomedical factors. Given that pain is an aversive event, fear-avoidance models of disability suggest that disability in chronic pain populations may in part be due to premorbid psychological factors that increase the likelihood of developing pain-related fear. Such factors include anxiety sensitivity, or one's proneness to become fearful of anxiety-related sensations (40), beliefs about the underlying nature of one's pain (18), as well as a person's experience with painful events.

DEPRESSION

Depression is reported to be highly prevalent among persons with chronic pain (41–45). Although depression can take many forms varying in the number and severity of symptoms, even milder symptoms of depression have been found to influence the experience of pain. More severe depression, such as the constellation of depressive symptoms that comprise a diagnosis of major depression according to the Diagnostic and Statistical Manual of Mental Disorders (46), has been estimated to impact 30–54% of persons with chronic pain according to a recent review of the literature by Banks and Kerns (45). While the exact mechanisms of how depression impacts function are not entirely clear, it has been proposed that depression may impair cognitive functioning which in turn decreases sustained concentration (44,45). Anhedonia and similar depressive symptoms may act to decrease motivation to sustain effort on tasks, while negative thoughts and beliefs that accompany depression may increase negative thoughts about pain (45,46). Combined, these symptoms may decrease beliefs that one can successfully perform certain tasks.

Several studies support an association between depression, heightened disability, and greater pain behavior in persons with chronic pain. One study reported that both somatic

and cognitive symptoms of depression are associated with poorer perceived psychosocial functioning among persons with chronic pain, even when controlling for pain intensity and other measures of effect (47). Somatic symptoms of depression, such as sleep disturbance and decreased energy, were also associated with perceived physical disability. Another study found that depressed persons with chronic pain, but not observers who rated level of pain behavior in the study, perceived themselves as displaying more pain behavior compared to nondepressed individuals with chronic pain (48). These results suggest that cognitive biases among depressed persons rating their perception of their behavior may be responsible for the above findings. Given that depressed persons often have a negative view of themselves and their experiences, it is possible that associations observed between depression function or behavior reported on questionnaires may reflect a depressed persons' tendency to rate or perceive things in a negative fashion. These negative perceptions and resulting bias may not accurately reflect more objective measures of function.

Despite this, some studies have also observed a relationship between depression and functional activity among persons with chronic pain. To examine the influence of a cognitive bias on reporting of disability among persons with chronic pain and depression, Geisser *et al.* (49) compared self-report of depressive symptoms with a measure of perceived disability and performance on a task of progressive isoinertial lifting. Depression was significantly associated with greater self-reported disability, and was also significantly related to lower maximum weight lifted during a progressive isoinertial lifting task. Thus, the association between depression and function did not appear to be due solely to a self-report bias. Similarly, another study examined the relationship between psychological factors and maximal effort during FCE (50). The authors found that persons who did not put forth maximal effort displayed a trend towards reporting more depressive symptoms.

CATASTROPHIZING

Some authors suggest that negative thoughts or beliefs about pain may mediate the relationship between depression, pain and disability. One such factor identified in the literature is pain catastrophizing, or responses to pain that characterize it as being awful, horrible, and unbearable. Early studies on catastrophizing suggested that these maladaptive responses to pain mirrored responses typically seen in persons with depression, and proposed that catastrophizing was merely a symptom of depression rather than a separate entity (51,52). Subsequent research revealed that catastrophizing has an impact on pain and disability independent of its association with depression (18,53–55). One study reported that catastrophizing was significantly related to perceived disability and employment status among persons with soft-tissue injuries to the neck, shoulders or back (56). Furthermore, castastrophizing maintained a significant association with increased disability even when controlling for anxiety and depression, while the influence of depression was no longer significant when controlling for the influence of catastrophizing. These findings support the notion that catastrophizing and negative beliefs about pain mediate the influence of depression on physical functioning.

A more recent study examined the relationship between catastrophizing and disability among 174 persons in the community with chronic pain secondary to spinal cord injury (57). Utilizing self-report measures, the authors found that a combination of pain coping

and catastrophizing accounted for 11% of the variance in disability after controlling for demographic variables, spinal cord injury variables (e.g., level of injury), and pain intensity. The authors concluded that catastrophizing, at least in part, may explain differences in activity levels among persons with similar physical impairment.

To explain how catastrophizing influences disability, Vlaeyen *et al.* (20) presented a model whereby catastrophizing contributes to a vicious cycle of pain-related fear leading to increased activity avoidance, depression and disability, which in turn contribute to increased pain and ultimately, higher pain-related fear. There is some evidence to suggest that catastrophizing may influence function or disability through its relationship to other pain beliefs such as pain-related fear. Turner *et al.* (58) found a significant association between catastrophizing and increased disability in a chronic pain sample. However, this relationship was no longer significant when controlling for the influence of various pain beliefs, including the belief that pain is a signal of damage or harm to the body.

POSTTRAUMATIC STRESS DISORDER

Posttraumatic stress disorder (PTSD) is increasingly being reported as a frequently occurring disorder among persons with chronic pain. For example, one study reported an incidence rate of 9.5% among patients seen at a multidisciplinary pain clinic (59). An even higher frequency of PTSD has been reported among persons with pain following a motor vehicle accident, as Hickling and Blanchard (60) reported an incidence rate of 50%, and 75% among persons consecutively referred to a psychologist for treatment of headache and other pain (61). These high reported rates are likely due to the setting. Another study reported that persons with chronic pain who endorsed symptoms of PTSD also reported the highest levels of pain and disability compared to persons whose pain did not result from trauma, or who had trauma related-pain but reported few or no PTSD symptoms (62). Similarly, patients with traumatic onset of fibromyalgia have been found to demonstrate greater pain, disability, life interference, and affective distress compared to fibromyalgia patients whose pain onset was insidious, even when controlling for disease severity (63). Another study reported that 56% of persons with fibromyalgia reported clinically significant levels of PTSD symptoms based on responses to a symptom inventory (64). These persons also reported greater pain, higher emotional distress, higher interference of pain on life activities, and greater disability compared to persons who reported few or no PTSD symptoms.

In a recent study among persons with pain secondary to HIV/AIDS, Smith *et al.* (65) examined the relationship between PTSD and disability among 145 patients enrolled in a clinical trial assessing the impact of a pain communication intervention. The authors indicated that 53.8% merited a diagnosis of PTSD based on responses to a symptom inventory. Persons with PTSD reported greater pain-related interference in activities of daily living and general activity.

While the relationship between PTSD symptoms and functional activity among persons with pain has not been specifically addressed in the literature, it is likely that it has an impact. This may be particularly true for persons who have pain due to injury, as avoidance of activities that remind a person of the accident is a diagnostic feature of the disorder. In addition, PTSD symptoms in this population are also associated with a higher incidence of mood disorders such as depression, which may also impact functioning.

SELF-EFFICACY

Another cognitive factor consistently related to functional activity is perceived self-efficacy. Self-efficacy is defined as the confidence one has that a particular behavior or other action can be performed and will produce a desired outcome. Other forms of self-efficacy have been examined in the pain literature, such as the belief that pain can be successfully managed, and beliefs related to the ability to successfully perform various functional activities (functional self-efficacy). As reviewed above, Rudy et al. (5) found that task-specific self-efficacy was the best predictor of physical performance among persons with chronic pain. Another study reported that decreased self-efficacy for function was significantly related to greater pain behavior among persons with fibromyalgia, while depression was unrelated (66). Functional self-efficacy has been found to be significantly associated with function as measured by lifting capacity, carrying, and pushing and pulling among persons with chronic low back pain, independent of expectancies of pain and reinjury (67). Another study reported that self-efficacy beliefs for managing pain significantly predicted pain behavior and activity avoidance 9 months later in a heterogeneous sample of persons with chronic pain (68). Lastly, one study found that functional self-efficacy was a better predictor of lifting ability compared to measures of perceived control over pain and psychological distress among persons with work-related back pain (69). Intuitively, this latter finding suggests that functional self-efficacy is a better predictor of functional activity compared to general beliefs that one is able to manage pain.

JOB FACTORS

While research has not directly examined the relationship between job factors and functional activity, there is very compelling evidence that job stress is associated with poor mental and physical health, and that job dissatisfaction is a risk factor for developing chronic disability. For example, job strain (defined as high psychological demands and low decision latitude) has been found to be associated with increased cardiovascular responsiveness and disease (70). Two large studies reported that interpersonal conflict at work was associated with a higher incidence of physician-diagnosed psychiatric problems (71), and increased work disability among women who reported simultaneous marital conflicts (72). Higher incidence of physical and psychiatric disease may place persons with low job satisfaction at risks for developing disabling conditions.

Some studies also suggest that work stress and work dissatisfaction are associated with increased risk of developing disability. One study indicated that persons who reported low work enjoyment were 2.5 times more likely to report a back injury compared to persons who reported high job satisfaction (73). In another study, a history of back complaints and job dissatisfaction were found to be the best predictors of back pain complaints compared to other physical and psychosocial factors (74). Finally, one study reported that return to work among persons treated for chronic pain was significantly associated with job stress, job physical demands, job liking, job role conflict, and a perception of work being dangerous (75).

Work stress and work satisfaction may impact function in several ways. Increased anxiety and stress may impair cognitive function, which in turn may impair physical performance. Heightened stress may also lead to greater fatigue, which in turn decreases function

and endurance. As noted above, these factors may also impact health, and decrease job interest and motivation to perform various activities.

ILLNESS BEHAVIOR

Several studies have examined the relationship between abnormal illness behavior and functional activity among persons with chronic pain, particularly chronic back pain. Often, illness behavior among persons with chronic low back pain is defined as the presence or absence of Waddell signs or symptoms (76,77). Waddell signs during physical examination include nondermatomal neurologic symptoms such as numbness, superficial tenderness, reported of low back pain with compression of the head, and no report of pain during straight leg raise when distracted when the patient complains of pain when not distracted.

One study found a significant relationship between the presence of Waddell signs (three to five) and a number of biomechanical variables assessing range of motion, isometric strength, and speed of movement among persons with low back pain of five or more weeks duration (78). Another study compared subjects who had low back and limb injuries on their performance on the ERGOS work simulator (79). The authors found that persons with back pain performed poorer compared to subjects with limb injuries. Among persons with low back pain, those with a high Waddell score were found to perform significantly worse on 12 of 13 strength measures, and 6 of 7 dexterity measures. One study reported that subjects with low back pain who had a high Waddell score performed poorer on measures of motor performance compared to low back pain subjects with a low Waddell score (80). These studies suggest that persons with low back pain and nonorganic signs perform poorly on a number of measures utilized as part of FCE. The presence of nonorganic signs has also been found to be a significant predictor of return to work among persons with acute low back pain (81).

While illlness behavior appears to be highly related to FCE measures, is it difficult to interpret exactly what "illness behavior" is. For example, Hirsch *et al.* (78) indicate that illness behavior may be related to 1) a failure to understand that maximum effort is being requested; 2) anxiety; 3) depression; 4) pain; 5) pain-related fear; 6) conversion reaction; or 7) malingering. Thus, when attempting to address causes of illness behavior, any number of factors may contribute.

SECONDARY GAIN

Secondary gain due to compensation, litigation, or other factors is frequently identified as a variable that interferes with effort and is associated with poor FCE performance. Malingering, or conscious faking of an injury, has been estimated to occur in 1.25–10.4% of persons with chronic pain (82), although the exact figure is difficult to ascertain as the measures used to assess malingering may lack validity. While secondary gain is frequently mentioned in the FCE literature as a factor related to poor effort, there is much debate in the pain literature regarding the importance of secondary gain on symptom presentation and disability. In fact, some argue that persons with chronic pain do not gain at all from their condition (83).

While few studies have directly examined the impact of litigation and compensation on functional status, several studies have examined the relationship between litigation and treatment outcome or return to work (84–88). It has been suggested that that secondary gain may not directly impact function, but may be associated with other variables that have a more direct impact on activity (89). In the Geisser *et al.* (17) study mentioned above, involvement in litigation was significantly associated with poorer lifting ability on the progressive isoinertial lifting evaluation.

Thus, the data on the impact of litigation and compensation status on function is mixed. As suggested by Dworkin *et al.* (89), it is possible that the results of studies finding a positive association between litigation and disability may be due to other factors associated with compensation. In addition, it is likely that pain patients receiving compensation are a heterogeneous group, which makes it difficult to that compensation is associated with disability on a case-by-case basis.

PSYCHOSOCIAL FACTORS AND FCE MEASURES OF SINCERITY OF EFFORT

Most FCEs employ some assessment of the level of effort put forth by the patient during testing. This information is then used to assess the validity of the evaluation. In clinical settings, the person conducting the FCE is often asked to provide ratings of level of effort. While the therapist can compare performance during FCE to other information such as their reported impairment in activities of daily living, there is little data regarding how accurate these types of ratings are. While one study reported a high association between prediction of performance by a physician and functional activity in persons with chronic pain, prediction of level of effort was more problematic (90).

For this reason, many advocate for more objective measures of level of effort. Most of these measures examine the consistency of patient responding, as it is presumed that feigned or submaximal efforts (i.e., performing below one's physical capabilities) on a particular task are difficult to reproduce, leading to high variability in responding and low reliability (91). One such measure, termed the coefficient of variation, is a measure of the variability in responding on repeated trials on a task. On this measure, it is proposed that sincere effort, or performance associated with full physiologic effort, is characterized by low variability in responding across trials. Insincere or submaximal efforts are purported to result in high variability in performance across trials, leading to a higher coefficient of variation. Other measures of sincerity of effort have been developed as well.

Most studies examining the impact of psychosocial factors on sincerity of effort measures have focused primarily on the influence of secondary gain and malingering. A recent, comprehensive review of these studies was published by Fishbain *et al.* (82). These authors review studies utilizing questionnaires, grip strength, isometric strength testing, and isokinetic strength testing. On the basis of the existing studies, the authors conclude that the coefficient of variation and isometric strength testing do not appear to discriminate sincere from insincere efforts. The authors indicate that isokinetic testing appears to have some potential for discriminating maximal from submaximal effort, although the authors indicate that the reason that isokinetic testing is superior to isometric testing is not clear from the literature. However, the authors reported that this finding may be due to the fact that isokinetic machines are able to change resistance, and accommodate

to muscular contraction. These abilities may make it easier to detect discrepancies in effort.

One study examined the sensitivity and specificity of heart rate increase on a lifting task as a measure sincerity of effort among 41 persons with a previous back injury who were instructed to give full and submaximal efforts (92). The authors found that utilizing heart rate increase as a measure of sincerity of effort correctly classified 86.8% of full and insincere efforts. This study suggests that examination of heart rate increase may be of benefit when examining sincerity of effort.

Other psychosocial factors have been found to influence measures of sincerity of effort as well. For example, one study found that pain behavior was associated with a higher coefficient of variation on a task of isokinetic trunk strength testing (93). The authors indicated that this relationship could not be interpreted as an attempt to "look bad" or "malinger." The authors also observed negative associations between measures of anxiety, dysthymia, somatization, and catastrophizing with measures of peak torque and range of motion. Positive associations were observed between perceived control over pain and range of motion and measures of peak torque. Another study found that self-report of pain, negative mood, and tendency to report physical symptoms were negatively associated with measures of variability during isometric strength testing (94). Several other psychosocial factors have been found to be related to submaximal effort including anxiety, depression, catastrophizing, and pain-related fear (82).

In summary, it is unclear whether sincerity of effort can be accurately assessed in pain populations, although Fishbain *et al.* (82) report that isokinetic testing holds some promise. There may be several reasons for this. One involves the premise that insincere efforts are inconsistent. One study reported that persons given instructions to perform submaximally on an isometric lumbar extension task were able to give a consistent performance at a submaximal level (95). Second, while many studies show group differences on various measure of submaximal effort, few have explored their sensitivity and specificity for identifying maximal and submaximal efforts. Finally, the optimal number of trials for obtaining a valid and reliable measure of submaximal effort is not known, although Robinson *et al.* (96) suggest that the stability of the coefficient of variation can be improved by increasing the number of trials.

DISCUSSION

A summary of the research on psychosocial factors and function is presented in Table I. We believe that the existing literature supports the notion that certain psychosocial factors influence functional activity and FCE measures. Specifically, pain-related fear, self-efficacy, and illness behavior have all been shown to be related to measures of function and/or FCE performance. There appears to be strong evidence that depression, catastrophizing and PTSD are related to self-reported function, but there is little data regarding whether these psychosocial variables are related to functional activity. While many self-report measures of function are deemed to be reliable and demonstrate good concurrent validity with physical function measures, it is unclear whether the findings of studies utilizing self-report are generalizable to FCE. The role that job factors such as job stress, or secondary gain may play on FCE, is unclear at the present time.

It should be noted that there is a paucity of studies that have directly examined the relationship between psychosocial factors and FCE. For this reason, we have attempted to

Table I. Summary of Results of Studies on Psychosocial Factors and Functions

Variable	Nature of relationship	Related to self-reported function	Related to functional activity
Anxiety/Pain-related Fear	Poorer function	Strong evidence	Strong evidence
Depression	Poorer function	Strong evidence	Weak evidence
Catastrophizing	Poorer function	Strong evidence	Weak evidence
Posttraumatic Stress disorder	Poorer function	Strong evidence	No evidence
Self-efficacy	Better function	Strong evidence	Strong evidence
Job dissatisfaction/Job stress	Poorer function	Moderate evidence	No evidence
Illness behavior/nonorganic signs	Poorer function	Some evidence	Strong evidence
Secondary gain	Poorer function	Some evidence	Weak evidence

integrate literature on psychosocial factors and disability from the chronic pain literature. Because of the paucity of research in this area and the heterogeneity of the studies reviewed, applying more systematic or quantitative review techniques to this literature was not deemed to be feasible or practical. Attempting to combine effect sizes or measures of association across a very heterogeneous set of studies might produce very misleading findings.

While it would be beneficial to test and examine an overriding hypothesis regarding the relationship between psychosocial factors and FCE, in truth, such a hypothesis does not exist. Many of the relationships between psychosocial factors and function are complex, and multiple mechanisms have been proposed to explain these relationships. We have attempted to outline these mechanisms in the paper. However, it is difficult to propose a meaningful, unified hypothesis to explain the relationship between psychosocial factors and function.

The intended contribution of this study is to critically evaluate the existing literature, and provide suggestions for future research. We believe that psychosocial factors play an extremely important role in function, and that this area warrants further study. We hope that the issues raised in the manuscript assist in the development of future research in this area.

Given that psychosocial factors appear to influence FCE, it would be beneficial to assess the degree to which psychosocial factors such as pain-related fear and self-efficacy influence the findings of FCE. For a comprehensive review of psychosocial self-report measures used in pain populations, the reader is referred to Jensen and Karoly (97). While measures of sincerity of effort may be beneficial in determining the validity of FCE assessment, they do not provide specific information as to why a particular individual performed submaximally as these measures appear to be influenced by a number of different factors. Screening for psychosocial factors such as depression and pain-related fear may be a useful adjunct to FCE assessment. Such measures would likely provide greater insight into the causes of submaximal performance, and might be useful in determining whether persons tested might benefit from further psychological or other evaluation.

Further study should be conducted to examine the relationship between pain and FCE performance. While pain is often given as a primary reason for restricting activity, evidence supporting this notion is lacking in the literature, and there is some data to suggest that anticipated pain rather than actual pain is more highly related to functional activity. One potential drawback of these studies was that pain was assessed during the functional task. There is some suggestion in the literature that there is a delay between functional activity and the experience of pain. For example, one study reported that the highest relationships between activity and pain were observed for pain ratings given 30 min after reporting

increased activity, and some indicate that the time lag may be even greater (98). Thus, persons with pain undergoing FCE may not be as concerned about how they might feel during functional activity as they are about how they might feel later on in the day, or even the next day. An experimental design where pain is periodically assessed for a period of time after performing activity would help to address this issue.

As indicated in the review, many psychosocial factors are highly intercorrelated. Thus, further research is needed to examine the relative importance of various psychosocial factors on function, and how these factors interact to influence functional activity. While many psychosocial factors have been purported to influence function, further research is needed to examine more comprehensive models of how these factors interact to influence activity. In addition, most research in this area has been cross-sectional, and little is known about whether psychosocial factors have a causal influence on function. Utilizing research designs that allow for the analysis of cause and effect relationships would be beneficial and would help to resolve this issue.

We point out that the review suggests that a number of psychosocial factors are related to measures of sincerity of effort. Often, submaximal effort on FCE is often labeled as secondary gain, or malingering, and may lead to a situation where further treatment is suspended or not considered. This is unfortunate as emerging research suggests that many of the psychosocial factors listed above are treatable, and intervention may improve the person's functional performance. For example, actual exposure to feared activities (i.e., in vivo exposure) as an intervention for reducing pain-related fear may have a significant impact on function in persons with pain. One study examined six subjects with chronic low back pain who underwent baseline observation, and then received either in vivo exposure to feared light-normal activity (such as such as lifting a child, mopping the floor, riding a bicycle, and lifting a crate from the trunk of a car) followed by exposure to graded activity (exercise), or graded activity followed by in vivo exposure (99). Among subjects who received in vivo exposure first, significant decreases in fear were observed following this exposure and were maintained over time. Subjects who received graded activity demonstrated declines in fear only when in vivo exposure was introduced. In addition, in vivo exposure also reduced negative thoughts about pain (catastrophizing), fear of pain, and self-reported disability. These treatment gains were maintained at a 1-year follow-up. Interestingly, decreases in self-reported pain were also observed, even though pain was not a target of the intervention, and one might expect pain to increase with greater function. The authors propose that declines in pain-related fear may reduce pain vigilance, resulting in declines in reported pain intensity.

It should also be noted that most of the research on measures of sincerity of effort has been conducted within the framework of looking at group differences on these measures. Little has been done in the way of examining the sensitivity and specificity of these measures to detect sincere and insincere performance, a critical issue in relation to the clinical application of these indices. There is some suggestion that isokinetic testing may hold some promise as a valid measure of sincere effort, although some research suggests that persons who are instructed to give insincere efforts are able to produce consistent efforts, bringing into question the basic assumption underlying many measures of sincerity of effort. A recent study by Jay *et al.* (92) suggests that examination of heart rate might also be useful in detecting sincere and insincere effort. This merits further study. However, one may need to proceed with caution when interpreting this data in subjects on medications that are known to suppress heart rate, such as beta-blockers.

Some advocate for examining job-specific activities during FCE (100), and doing so may have advantages in terms of increasing sensitivity to the identification of psychosocial factors that may influence job performance. Many acknowledge that the relationship between FCE performance and return to work has received little empirical attention, and it is not known how performance on certain tasks during FCE translates into ability to perform specific work tasks (1,2). Recently, one investigation reported that gender and time off work were the strongest predictors of return to work among 650 adults who underwent FCE evaluation (101). Despite this, some argue that simulation of specific work-related tasks are likely better predictors of ability to return to work. In this vein, it might be beneficial to perform FCEs on-site at the workplace. It would be beneficial to compare whether more general FCE's or those that assess specific work tasks are more highly related to actual job performance. Also, work-site FCEs might better capture how factors such as pain-related fear might impact work performance. Persons may have highly variable fears about particular activities, and decreasing fear of one particular activity does not necessarily generalize to other activities (102,103). Thus, the relative influence of psychosocial factors on function may vary depending on the activity.

The literature reviewed above demonstrates the strong influence of psychosocial factors in chronic pain conditions and in the assessment of these patients' function. Maximizing "true" estimates of functional capacity requires examination of psychosocial contributors. Furthermore, it may be necessary to go beyond the measurement of these psychosocial contributors to interventions aimed at reducing maladaptive psychosocial influences. Given the complex nature of the general problem, some of the interventions may be limited by the inability to influence systems out of the patient's control (i.e., insurance and legal influences). Future research needs to examine FCE in more complex models that include the relevant psychosocial variables described above. There is also a strong need to reduce the error in FCE that comes from non-standardized protocols. Finally, there is a need to examine experimental designs that manipulate the influence of psychosocial variables on FCE measures to better elucidate causal relationships.

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