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The Million Visual Analog Scale

Its Utility For Predicting Tertiary Rehabilitation Outcomes

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Study Design. A longitudinal cohort study involving 1749 patients with chronically disabling spine disorder (CDSD) who underwent tertiary rehabilitation investigated the relation between the Million Visual Analog Scale (MVAS) score and treatment outcome.

Objectives. To determine whether the pretreatment MVAS rating of disability severity is associated with the ability to complete functional restoration rehabilitation, and to determine whether pre- or posttreatment MVAS disability perception is associated with 1-year posttreatment socioeconomic outcomes. The relation of the MVAS to pre- and posttreatment psychosocial measures and physical performance levels also was evaluated.

Summary of Background Data. The MVAS yields a total functional disability score ranging from 0 to 150. Like other "disability inventories," the MVAS differs from a "pain inventory" in that the focus is on disability and function, as opposed to self-reported pain. The MVAS may currently be the most powerful functional rating scale because all its questions relate to the patient's ability to perform activities of daily living. It also has the advantage of a visual analog format, which typically is considered more effective than other commonly used self-report formats.

Methods. A large cohort of 1749 patients with CDSD who underwent tertiary rehabilitation was divided into groups by their severity of disability, rated on the MVAS, both at pre- and posttreatment assessment. The patients were divided into groups ranging from "no reported disability" (MVAS = 0) to "extreme disability" (MVAS = 131–150). The distribution into the six groups was assessed on both pre- and posttreatment MVAS ratings. The patients underwent a 3-week functional restoration program consisting of daily quantitatively directed exercise progression and multimodal disability management. Physical capacity and psychosocial assessments, performed before and after treatment, were correlated with the MVAS scores. A 1-year posttreatment clinical interview obtained information on socioeconomic outcomes, which also were correlated with the MVAS ratings.

Results. Mantel–Haenszel linear analyses showed a number of relations between demographic variables and both pre- and posttreatment MVAS scores. Most importantly, the findings showed that severe pretreatment MVAS scores were associated with a lower program completion rate (94% *vs* 89%; $P < 0.001$) and a higher rate of postrehabilitation health care use from a new provider (12% *vs* 41%; $P < 0.001$). Prerehabilitation scores also were linearly related to lower levels of pretreatment physical performance and higher rates of pretreatment depression. More severe posttreatment MVAS scores were associated linearly with a drop in the work return rate from 93% to 63%, a drop in the work retention rate 1 year after rehabilitation from 86% to 44%, and a drop in the financial settlement rate from 94% to 79% ($P < 0.001$). A linear trend also was found in the rate of postrehabilitation surgeries, with the percentages rising from 0% in the group with no reported disabilities to 12% in the group with extreme disabilities ($P < 0.001$).

Conclusions. The current study represents the first large-scale examination of the relation between MVAS ratings and treatment outcomes in a CDSD population. These results demonstrate the effectiveness of a simple disability rating scale, such as the MVAS, for systematic disability assessment in potentially predicting treatment outcomes in patients with CDSD. Despite the popularity of other questionnaires, the MVAS is the first disability inventory with demonstrated effectiveness for this purpose in a large CDSD population. [Key words: chronic pain, depression, disability questionnaire, functional restoration, Million Visual Analog Scale, outcome measures, physical–functional capacity, rating scale, tertiary rehabilitation] **Spine 2003;28:1051–1060**

The economic impact of chronic disabling spinal disorders, particularly chronic low back pain, is disturbingly high, and has been well established over the years.[1,2] In the United States, the combined costs of medical expenses, compensation, lost earnings, and lost productivity for low back pain is approximately $100 billion a year.[3,4] Although chronic back pain ultimately develops in only 5% to 10% of all individuals who experience an episode, this small percentage of patients is responsible for approximately 80% of the medical costs for all back treatment.[5,6] Because of the great economic cost and traditionally poor outcomes for patients with chronically disabled spine disorder (CDSD), alternative management methods to deal with this problem are beginning to develop. In addition to the development of new therapeutic strategies, there has been renewed interest in identifying demographic, psychological, and socioeconomic

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variables that may contribute to chronicity and treatment outcome.[4,7–13]

Measurement of clinical outcome, through either objective means or self-report instruments, is an essential element of any musculoskeletal rehabilitation program. Whereas the decline and eventual cessation of diseases such as viral and bacterial infections can be clearly and objectively documented, chronic musculoskeletal pain (CMP) disorders such as spinal disorders pose a more difficult problem.[14,15] Musculoskeletal disorders involve a complex interaction of physiologic, psychological, and social factors that is difficult to evaluate using traditional biomedical techniques. One principle difficulty that clinicians have long encountered is that CMP disorders most often cannot be traced to a precise pathoantomic cause.[16–19] Even recent advances in musculoskeletal imaging have yielded little improvement allowing clinicians to evaluate etiology more accurately.[20] This further complicates the reliable assessment of clinical outcomes. As a consequence of this complexity, both clinicians and researchers alike have acknowledged the evaluation of "functional status" as essential in the treatment of patients with CMP.[14,21,22]

Measures of muscle strength, spinal mobility, employment status, and a variety of psychosocial variables have been used singly and in combination to describe functional status.[14,23,24] Traditionally, physiologic measures such as range of motion and muscle strength have been preferred over self-report measures such as indexes examining disability and tasks of daily living.[25] Consequently, until only recently, physiologic measures of outcome were given precedence clinically, and less attention was given to the development of more sophisticated self-report instruments to assess functional status and disability. However, research has shown the distinction between many physiologic and self-report data to be minimal. For instance, a great deal of variability has been shown between range of motion measures.[26,27] Furthermore, physiologic indexes of functional status rarely correlate with measures of pain and disability attained through clinical observation or patient self-report.[24,28] As a consequence, clinicians and researchers have shown a growing tendency to rely on the assessment of functional status and disability by means of patient self-report.[29]

The development of self-report instruments designed to assess functional status and disability have greatly proliferated over the past decade, highlighting recognition of the individual patient's specific, subjective experience of pain and how it affects his or her ability to function in daily life as a key element of treatment outcome.[30,31] For example, a variety of instruments examining activities of daily living have been developed, most often focusing on the manner in which a patient's musculoskeletal injury affects everyday tasks such as sitting, sleeping, lifting, and walking.[14] Although there still is no clear "gold standard" among CMP outcome measures, clinical research has found measures of patients' perceived functional capacity to be a valuable asset.[32–34] Interestingly, many of the self-report instruments used by a variety of clinicians make the claim of being a "disability" index or questionnaire. Waddell *et al*[35] defined disability as an "inability to do normal work," whereas others have characterized it as "a restriction in a person's ability to perform socially defined roles."[22] Each definition acknowledges the complex interaction of different variables likely to affect patients' ability to manage their pain or injury adequately in a number of life roles. Likewise, Hildebrandt *et al*[36] showed that the most important indicator of successful treatment for chronic back pain is a reduction in patients' feelings of disability, as defined by their ability, or lack thereof, to perform the routine activities essential to function in society.

No particular self-report instrument of disability or functional status has established itself as superior to others within the CMP population.[37,38] For example, the Oswestry Low Back Pain Disability Questionnaire is the oldest and most thoroughly researched instrument designed to assess functional status and disability.[21,39–41] However, it may have a significant weakness, as noted in studies suggesting a possible floor effect, such that extremely low scores may not be as accurate as more moderate or high scores.[37,41,42] The Roland Morris Disability Questionnaire primarily measures physical functional abilities such as dressing, walking, and lifting.[43] The validity of the instrument, however, has received only a mild degree of scrutiny, and it has proved to be the least sensitive measure of clinically meaningful change, as compared with other prominent indexes of functional status.[44,38] It also is less sensitive at detecting change when disability is classified as severe, likely a shortcoming that can be attributed to the two-level response format of the questionnaire.[38,41]

The SF-36 is a multipurpose, short-form health survey.[29] Although it generally is not considered to be a traditional functional status or disability instrument, such as the Oswestry Disability Questionnaire, the SF-36 has been used as an outcome measure in numerous studies investigating low back pain.[45–47] However, it still is uncertain whether this is a valuable outcomes instrument in the CMP population.[46] Finally, other less studied indexes such as the Waddell Disability Index,[48] the Low Back Outcome Score (LBOS),[49] the Quebec Back Pain Disability Scale,[42] and the Functional Rating Index (FRI)[40] show promising beginnings, but still have a small research literature.[21] Whereas the Functional Rating Index was normed with a heterogeneous group of patients with spinal disorder, the other instruments were intended originally for a low back pain population. Furthermore, each instrument primarily measures physical functional capacity, placing little emphasis on psychosocial factors. Because studies investigating these measures are lacking, conclusions regarding their validity cannot yet be made.

The Million Visual Analog Scale (MVAS), which won the 1981 Volvo Award in clinical science, has been the

focus of few studies since its development, although initial investigations concerning its test–retest reliability and other psychometric properties have been promising.[50,51] The 15 items of this instrument, presented in the Appendix, are scored using visual analog scales anchored to allow responses ranging from best to worst case scenarios. Such scales inherently increase the response categories available, rely less on verbal skills, and are more sensitive to measured change.[52] The clinical validity of the MVAS still is not clearly established. The current investigation, therefore, was designed to evaluate comprehensively the validity of the MVAS in predicting socioeconomic outcomes, which are relatively objective benchmarks of work-related functioning. The goal was to investigate the association of pre- and posttreatment MVAS scores with socioeconomic, physical, and psychosocial treatment outcomes. Also, the authors were interested in determining whether pretreatment MVAS scares are associated with the ability to complete functional restoration rehabilitation, and whether posttreatment MVAS disability perception is associated with 1-year posttreatment socioeconomic outcomes (*e.g.,* work status, health care utilization). The relation of the scale to pre- and posttreatment psychosocial measures and to physical performance levels also was evaluated.

■ Materials and Methods

Participants. The study participants consisted of 1749 consecutive and prospectively evaluated patients with CDSD who consented to a prescribed course of functional restoration treatment at the Productive Rehabilitation Institute of Dallas for Ergonomics (PRIDE) and began the treatment between January 1993 and January 1999. All the patients in the study had received previous treatment for their injury. However, their disability had not resolved at the time of admission to this tertiary interdisciplinary treatment program. The criteria for inclusion in the treatment program required a period of more than 4 months since a work-related injury, acute conservative care that had failed or was deemed unnecessary, surgery that had not produced resolution or simply was not an option, and ability to speak English or Spanish.

Procedure. All the patients received an initial evaluation consisting of a medical history, physical examination, psychological intake interview, medical case management disability assessment interview, and a quantitative physical–functional capacity evaluation. At the time of the initial interview, physical and functional capacity measurements normalized to age, gender, and body weight were performed, resulting in a "cumulative score" that was calculated both before and after treatment. This cumulative score (CS) is an aggregate score that accounts for patients' performance on a variety of physical tests.[53,54] The following psychosocial instruments were administered before treatment began and again after its completion: the Quantified Pain Drawing, which includes an analog self-report of perceived pain intensity; the MVAS, and the Beck Depression Inventory (BDI).[55] These psychosocial instruments have been shown to have good reliability and treatment-responsiveness validity when used with patients with chronic low back pain.[56]

The 1-year contact rate for patients during the study period was 91%. At the 1-year follow-up assessment, a structured telephone interview was conducted to evaluate a number of objective socioeconomic outcome variables. Dimensions of socioeconomic information included work return, posttreatment health care utilization, recurrent injury claims, case settlement, medications, treatment satisfaction, and residual pain. Such structured telephone interviews have been described previously.[57–59] Although reliability data for these structured interviews have not been published, the authors had occasion to reexamine both the 1-year and 2-year telephone interview findings for the patients evaluated in their earlier 2-year follow-up study.[42] The test–retest reliability coefficients comparing computations of the responses collected during the two periods were found to be high (*e.g.,* an r value of 0.92 for the number of visits to health care professionals).

The treatment program consisted of quantitatively directed exercise progression supervised by physical and occupational therapists. The physical training occurred in conjunction with multimodal disability management, which included individual counseling, group therapeutics, stress management, biofeedback, coping skills training, and education focusing on disability management, vocational reintegration, and future fitness maintenance.[60–63]

Statistical Analyses. To evaluate the presence of linear trends across six separate MVAS categories (zero, mild, moderate, severe, very severe, and extreme), the Mantel–Haenszel statistic for linear analysis was applied when the dependent variable was categorical. For continuous variables, an analysis of variance (ANOVA), with a test for linearity, was applied to the data. To calculate odds ratios in some subsequent analyses, the zero, mild, and moderate MVAS categories were combined into one larger cohort (group A), and the severe, very severe, and extreme MVAS categories were combined into a second large cohort (group B). It should be noted that in all analyses, the MVAS categories were used as the independent variable.

■ Results

On the basis of disability severity rated on the MVAS before and after treatment assessments, this patient cohort was divided into significant groups. The ratings for the six groups were as follows: no reported disability (0), mild disability (1–40), moderate disability (41–70), severe disability (71–100), very severe disability (101–130), and extreme disability (131–150). These groups were determined on the basis of natural breaks in a scatter plot showing the distribution of all the MVAS scores in this cohort. This resulted in a relatively normal distribution of the category score frequencies.

Demographic Variables

The demographic information from the initial intake interview was examined for the entire initial cohort (n = 1749) according to pretreatment MVAS score category (Table 1). It should be noted that in all the analyses to be presented, the MVAS is treated as the independent variable. The Mantel–Haenszel statistic showed that gender varied along a linear trend, with the percentage of men decreasing significantly as pretreatment MVAS scores increased ($X^2[1] = 12.8$; $P < 0.001$). Furthermore,

Table 1. Demographic Characteristics by Pretreatment Score on the MVAS (n = 1,749)

Variable	Mild* (1–40) 54 (3%)	Moderate (41–70) 240 (14%)	Severe (71–100) 785 (45%)	Very Severe (101–130) 626 (36%)	Extreme† (131–150) 44 (2%)	*P* Value (Linear Trend)
Age (X, SD)	40 (10)	41 (10)	41 (10)	41 (10)	41 (9)	0.56
Gender						<0.001
Male, N (%)	39 (72%)	166 (69%)	498 (63%)	378 (60%)	21 (48%)	
Female, N (%)	15 (28%)	74 (31%)	287 (37%)	248 (40%)	23 (52%)	
Race†						0.27
(N, % White)	39 (74%)	167 (70%)	552 (72%)	424 (69%)	29 (66%)	
(N, % Black)	6 (11%)	23 (10%)	83 (11%)	68 (11%)	8 (18%)	
(N, % Hispanic)	8 (15%)	47 (20%)	130 (17%)	118 (19%)	7 (16%)	
(N, % other)	0 (0%)	3 (1.3%)	5 (0.6%)	4 (0.7%)	0 (0%)	
Length of disability (mo) (X, SD)	12 (8)	18 (37)	17 (16)	19 (22)	18 (14)	0.05
Pretreatment surgery to injured area (N, %)§	14 (26%)	68 (29%)	195 (25%)	172 (28%)	12 (30%)	0.46

* There was no MVAS scores of zero at pretreatment.
† There was one MVAS score of 150 at pretreatment.
‡ 28 patients were missing unequivocal race categorization (1 = mild; 0 = moderate; 15 = severe; 12 = very severe; 0 = extreme).
§ 20 patients had missing data on this variable (1 = mild; 4 = moderate; 7 = severe; 4 = very severe; 4 = extreme).

ANOVA showed a linear increase in the length of disability as posttreatment MVAS scores increased ($F[1,1794] = 3.8$; $P = 0.05$). No other significant demographic differences were found with regard to pretreatment MVAS scores.

The demographic data regarding posttreatment MVAS scores for the patients who completed the treatment program (n = 1562) are presented in Table 2. A Mantel–Haenszel analysis showed that whereas the percentages of whites and African-Americans decreased as posttreatment MVAS scores increased, the percentage of Hispanic patients significantly increased ($X^2[1] = 28.3$; $P < 0.001$). Moreover, ANOVA showed an increase in age as posttreatment MVAS scores increased ($F[1,1283] = 13.9$; $P < 0.001$). No other significant demographic differences were found with regard to posttreatment MVAS scores.

Pretreatment MVAS Scores

Table 3 presents the statistical analyses of the 1-year work, health care utilization, recurrent injury, and case settlement outcomes regarding pretreatment MVAS scores of the initial cohort of 1749 patients. As is evident, pretreatment MVAS scores were associated with a number of significant results. Importantly, the percentage of patients who did not complete the tertiary rehabilitation program significantly decreased as MVAS scores increased ($X^2[1] = 13.9$; $P < 0.001$), as did the percentage of patients returning to work ($X^2[1] = 40.0$; $P < 0.001$). The percentage of patients retaining work at 1 year decreased as MVAS scores decreased ($X^2[1] = 30.6$; $P < 0.001$), as did the percentage of patients returning to their same employer ($X^2[1] = 34.9$; $P < 0.001$). Furthermore, the percentage of patients working more than 40 hours each week decreased as MVAS scores increased ($X^2[1] = 37.8$; $P < 0.001$), whereas the percentage of patients seeking health care from a new provider increased with pretreatment MVAS scores ($X^2[1] = 17.7$; $P < 0.001$). As might be expected, the average number of visits to a new provider significantly increased as MVAS scores increased ($F[1,69] = 16.5$; $P < 0.001$).

Table 2. Demographic Characteristics by Posttreatment Score on the MVAS (n = 1,562)

Variable	Zero (0) 17 (1%)	Mild (1–40) 341 (22%)	Moderate (41–70) 513 (33%)	Severe (71–100) 499 (32%)	Very Severe (101–130) 174 (11%)	Extreme* (131–150) 18 (1%)	*P* Value (Linear Trend)
Age (X, SD)	39 (10)	40 (9)	41 (10)	42 (9)	44 (10)	41 (7)	<0.001
Gender							0.30
Male, N (%)	12 (71%)	212 (62%)	329 (64%)	316 (63%)	104 (60%)	11 (61%)	
Female, N (%)	5 (29%)	129 (38%)	184 (36%)	183 (37%)	70 (40%)	7 (39%)	
Race†							<0.001
(N, % White)	13 (77%)	250 (75%)	371 (73%)	356 (73%)	106 (61%)	11 (65%)	
(N, % Black)	2 (12%)	38 (11%)	53 (11%)	46 (9%)	17 (10%)	1 (6%)	
(N, % Hispanic)	2 (12%)	43 (13%)	77 (15%)	85 (17%)	51 (29%)	5 (29%)	
(N, % other)	0 (0%)	3 (0.9%)	5 (1.0%)	4 (0.8%)	0 (0%)	0 (0%)	
Length of disability (mo) (X, SD)	12 (11)	17 (21)	17 (18)	19 (28)	17 (25)	25 (21)	0.07
Pretreatment surgery to injured area (N, %)‡	2 (12%)	89 (26%)	135 (27%)	133 (27%)	50 (29%)	7 (39%)	0.12

* There were no MVAS scores of 150 at posttreatment.
† 23 patients were missing unequivocal race categorization (7 = mild; 7 = moderate; 8 = severe; 0 = very severe; 0 = extreme).
‡ 11 patients had missing data on this variable (0 = zero; 2 = mild; 4 = moderate; 5 = severe; 0 = very severe; 0 = extreme).

Table 3. One-Year Work, Health Utilization, Recurrent Injury, and Case Settlement Outcomes Based on Pretreatment Score on the MVAS (n = 1,749)

Variable	Mild (1–40) 54 (3%)	Moderate (41–70) 240 (14%)	Severe (71–100) 785 (44%)	Very Severe (101–130) 626 (36%)	Extreme (131–150) 44 (3%)	*P* Value (Linear Trend)
Completers (%)	94	95	92	88	89	<0.001
Return to work (%)	82	92	88	80	60	<0.001
Work retention (%)	80	86	82	74	54	<0.001
Same employer (%)	44	44	36	25	22	<0.001
Working 40+ h/wk (%)	72	74	69	57	43	<0.001
New surgery to original site (%)	1.9	4.9	3.3	4.0	5.0	0.39
% seeking healthcare from a new provider	12	23	26	31	41	<0.001
# of visits to a new provider (X, SD)	0.4 (1)	0.9 (2)	1.1 (2)	1.3 (2)	1.5 (2)	<0.001
New injury to same body part w/lost time (%)	0	1.9	2.3	2.2	0	0.34
Case settlement (%)	85	91	92	92	94	0.09

The significance of these findings is that patients who rated their disability as higher also are were "physician shopping" for additional care after what promised to be the last realistic nonoperative treatment for their chronic disabling condition. These two variables together most likely reflect a higher degree of somatization disorder associated with the patient's perceived severity of disability. There were no significant differences in surgery rates, recurrent injury rates, or claims settlements.

Table 4 presents another analysis of the 1-year work and socioeconomic outcomes, in which pretreatment clustered MVAS scores were analyzed by odds ratios (OR). In this analysis the mild and moderate groups comprised Cohort A, whereas the severe, very severe, and extreme groups comprised Cohort B. Cohort A was 1.7 times more likely to return to work at 1 year than Cohort B (OR, 1.7; 95% CI, 1.1–2.6). Furthermore, Cohort A was 1.6 times more likely to retain work at 1 year (OR, 1.6; 95% CI, 1.1–2.2), 1.7 times more likely to return to their same employer (OR, 1.7; 95% CI, 1.3–2.3), and 1.6 times more likely to be working more than 40 hours per week at 1 year (OR, 1.6; 95% CI, 1.2–2.2) than Cohort B. Additionally, Cohort B was 1.5 times more likely to seek additional health care from a new provider (OR, 1.5; 95% CI, 1.1–2.1).

Table 5 presents the analyses of physical and psychosocial measures by total pretreatment MVAS score. It should be noted that there were a number of patients who did not complete treatment. Consequently, the number of patients tested and evaluated for outcomes decreased from the pretreatment MVAS to posttreatment MVAS. The pretreatment physical cumulative score decreased as MVAS scores increased ($F[1736] = 311.8$; $P < 0.001$). The posttreatment physical cumulative score also decreased as the MVAS score increased ($F[1329] = 19.3$; $P < 0.001$). The two psychosocial measures (Beck Depression Inventory [BDI] and pain intensity VAS) showed similar significant linear trends associated with increasing MVAS, as would be expected. On the pretreatment assessment, only the MVAS mild group was in the nondepressed range, whereas the extreme group displayed scores in the moderate to severely depressed range (mean, 24). Whereas all BDIs improved with treatment, only the very severe and extreme groups showed mean BDI scores in the mildly depressed range. Similarly, pain intensity increased substantially across the range at pretreatment, but the pretreatment MVAS scores also were associated with posttreatment pain intensity scores!

Posttreatment MVAS Scores

Table 6 presents the socioeconomic outcomes based on the posttreatment MVAS scores. Again, it should be noted inasmuch as a number of patients did not complete the treatment, the number of patients tested and correlated to outcomes decreased from pretreatment MVAS (n = 1749) to posttreatment MVAS (n = 1562). As can be seen, the percentage of patients returning to work at 1 year decreased ($X^2[1] = 59.3$; $P < 0.001$), as did the percentage of patients retaining work at 1 year ($X^2[1] = 74.5$; $P < 0.001$). Furthermore, the percentage of patients returning to their same employer decreased as posttreatment MVAS scores increased ($X^2[1] = 35.9$;

Table 4. One-Year Work and Socioeconomic Outcomes Analyzed by Odds Ratios Based on Pretreatment Clustered Scores on the MVAS (n = 1,749)*

Variable	Group A (n = 294)	Group B (n = 1,455)	OR (95% CI)	χ^2	*df*	*P* Value
Return to work	90%	84%	1.7 (1.1, 2.6)	6.2	1	<0.01
Work retention	85%	78%	1.6 (1.1, 2.2)	6.0	1	<0.01
Same employer	43%	31%	1.7 (1.3, 2.3)	16.5	1	<0.001
Working 40+ h/wk	74%	63%	1.6 (1.2, 2.2)	10.8	1	<0.001
% Seeking healthcare from a new provider	21%	29%	1.5 (1.1, 2.1)	7.0	1	<0.01

* In which the mild and moderate groups comprise cohort A, and the severe, very severe, and extreme groups comprise cohort B.

Table 5. Physical and Psychosocial Measures by Pretreatment Score on the MVAS

Variable	Mild (1–40)	Moderate (41–70)	Severe (71–100)	Very Severe (101–130)	Extreme (131–150)	*P* Value (Linear Trend)
Cumulative score (PRE) (X, SD)	53 (20)	49 (15)	40 (15)	32 (15)	23 (13)	<0.001
Cumulative score (POST) (X, SD)	79 (16)	73 (18)	73 (17)	70 (17)	62 (18)	<0.001
BDI (PRE) (X, SD)	9 (10)	11 (8)	15 (10)	19 (10)	24 (10)	<0.001
BDI (POST) (X, SD)	5 (7)	7 (8)	9 (9)	12 (10)	13 (10)	<0.001
Pain intens. (PRE) (X, SD)	5.1 (3.2)	5.6 (2.2)	6.6 (3.7)	7.3 (1.9)	7.9 (2.2)	<0.001
Pain intens. (POST) (X, SD)	3.3 (2.2)	4.0 (2.5)	4.8 (4.6)	5.6 (2.4)	6.5 (2.9)	<0.001

$P < 0.001$), as did the percentage of patients working more than 40 hours per week ($X^2[1] = 80.2$; $P < 0.001$). Additionally, the percentage of patients receiving new surgery at the original site of injury increased ($X^2[1] = 49.0$; $P < 0.001$), and the percentage of those seeking health care from a new provider also increased significantly as MVAS scores increased ($X^2[1] = 64.0$; $P < 0.001$). Specifically, the number of visits increased from 0.6 in the mild group to 1.8 in the extreme group ($F[1,258] = 69$; $P < 0.001$). The case settlement percentage significantly decreased as posttreatment MVAS scores increased ($X^2[1] = 23.8$; $P < 0.001$).

Table 7 presents another analysis of these data, in which posttreatment clustered scores on the MVAS are analyzed by odds ratios. In this analysis, the no disability, mild, and moderate groups comprise Cohort A, whereas the severe, very severe, and extreme groups comprise Cohort B. Basically, these findings show that those with lower self-reported disability have more favorable socioeconomic outcomes at 1 year. Cohort A was 3.1 times more likely than Cohort B to return to work at 1 year, and 3 times more likely to have retained work at 1 year. Cohort A also was 1.9 times more likely to return to their same employer, and 2.6 times more likely to be working more than 40 hours per week. Furthermore, Cohort B was 3.8 times more likely to have received new surgery at the original site of injury, and 2.2 times more likely to have sought additional health care from a new provider. Cohort A was 2.3 times more likely to have settled financially.

Table 8 presents physical and psychosocial measures based on posttreatment MVAS scores. A repeat physical and psychosocial battery was performed at about the same time as posttreatment MVAS. Not surprisingly, there are strong trends associating the physical cumulative score, BDI, and pain intensity VAS to the disability-oriented MVAS. Overall, these results confirm the tendency of greater physical inhibition and depression to be associated with higher scores on the MVAS, whether the MVAS is obtained before or after treatment.

■ Discussion

The current study was designed to evaluate the relation between MVAS ratings taken at two points in time (at pretreatment and posttreatment) and treatment outcomes among patients with CDSD. For posttreatment scores, the association of the MVAS with the following were investigated: meaningful 1-year socioeconomic outcomes such as return-to-work status and rates of health care resource usage as well as physical and psychosocial outcome measures. For pretreatment scores, the association of the MVAS with successful completion of the tertiary rehabilitation program also was evaluated. Specifically, this is the first known CDSD study to analyze a disability index categorically by severity scores, and to investigate how such categories relate to long-term treatment outcome. The results showed a substantial number of associations between MVAS scores and a variety of socioeconomic, physical, and psychosocial outcomes.

The pretreatment MVAS scores were found related to noncompletion of an interdisciplinary functional restoration program. This is a particularly important finding because clinicians may be able to use such data to identify at-risk patients early in the course of treatment and offer remedial care designed to keep such patients from leaving treatment prematurely. Additionally, higher pretreatment MVAS scores were associated with lower levels of work return and work retention, highlighting the

Table 6. One-Year Socioeconomic Outcomes by Posttreatment MVAS Score (n = 1,562)

Variable	Zero (0) 17 (1%)	Mild (1–40) 341 (22%)	Moderate (41–70) 513 (33%)	Severe (71–100) 499 (32%)	Very Severe (101–130) 174 (11%)	Extreme (131–150) 18 (1%)	*P* Value (Linear Trend)
Return to work (%)	93	94	92	83	75	63	<0.001
Work retention (%)	86	91	87	74	69	44	<0.001
Same employer (%)	43	43	38	28	21	19	<0.001
Working 40+ h/wk (%)	86	78	75	59	48	38	<0.001
New surgery to original site (%)	0	0.6	2	3	12	12	<0.001
% seeking healthcare from a new provider	25	14	23	31	44	47	<0.001
# of visits to a new provider (X, SD)	0.8 (1.5)	0.6 (1.6)	0.9 (1.7)	1.4 (2.2)	1.9 (2.4)	1.8 (2.1)	<0.001
New injury to same body part w/lost time (%)	0	1.9	1.7	2.6	1.3	0	0.44
Case settlement (%)	94	95	95	91	85	79	<0.001

Table 7. One-Year Work and Socioeconomic Outcomes Analyzed by Odds Ratios Based on Posttreatment Clustered Scores on the MVAS (n = 1,562)*

Variable	Group A (n = 871)	Group B (n = 691)	OR (95% CI)	χ^2	*df*	*P* Value
Return to work	93%	80%	3.1 (2.2, 4.3)	47.8	1	<0.001
Work retention	89%	72%	3.0 (2.3, 4.0)	63.0	1	<0.001
Same employer	40%	26%	1.9 (1.5, 2.4)	30.1	1	<0.001
Working 40+ h/wk	77%	55%	2.6 (2.1, 3.3)	80.0	1	<0.001
New surgery to original site (%)	2%	6%	3.8 (2.0, 7.1)	18.7	1	<0.001
% Seeking healthcare from a new provider	20%	35%	2.2 (1.7, 2.8)	43.8	1	<0.001
Case settlement	95%	89%	2.3 (1.5, 3.5)	17.0	1	<0.001

* In which the no disability, mild and moderate groups comprise cohort A, and the severe, very severe, and extreme groups comprise cohort B.

ability of the MVAS further to identify patients unlikely to have a positive socioeconomic outcome. Such patients also tend to seek additional health care providers and to have higher levels of self-reported depression and pain, which indicates the strong association of MVAS scores with a wide variety of factors.

Posttreatment MVAS scores also are associated strongly with a variety of important socioeconomic outcome measures. Specifically, higher posttreatment MVAS scores are associated with lower levels of work return and work retention, and higher rates of new surgeries and additional visits to a new health care provider. When the no disability, mild disability, and moderate disability groups are combined and compared with the remaining groups, the former groups were found to be three times more likely to return to work than the remaining groups. Likewise, the severe, very severe, and extreme disability groups were almost four times more likely to have had a new surgery, and are more than two times more likely to seek health care from a new provider. Thus, posttreatment MVAS scores are particularly robust in their association with a variety of socioeconomic outcomes 1 year after the MVAS has been administered posttreatment.

An additional interesting finding of this study was the fact that more men had scores in the mild and moderate categories than women, and more than an expected percentage of women had scores in the higher categories. This, however, was not surprising in light of other research showing a higher prevalence of disability among women, as well as gender differences in physical–medical and psychosocial variables influencing pain and disability.[64] Berkley[8] and Unruh[65] also noted that differences in attitudes about pain between genders may have an effect on rehabilitation response. In addition, Riley *et al*[66] conducted a meta-analyses investigating gender-related differences in the perceptions of painful stimuli through an examination of pain threshold and tolerance. They found that men exhibited a higher mean tolerance for pain and a higher pain threshold than women for several pain methods. They also noted that gender-related differences in body size may mediate pain perception, as well as the stage of the female menstrual cycle. McGeary *et al*[67] further discussed possible gender-related physiologic differences in how pain is perceived. Additional research is needed to evaluate whether these statistically significant results have any major clinical significance in terms of treatment outcomes.

As discussed earlier, the MVAS has been used very little, as compared with other more researched instruments such as the Oswestry and Roland–Morris.[37,38] Although some studies have shown the MVAS to possess predictive validity similar to that of the Oswestry and Roland–Morris, only four studies have examined such properties of the MVAS.[21] However, neither Oswestry nor Roland–Morris scores have been investigated using the categorical system used in the current study. Whereas many previous studies using these instruments have indicated each to possess predictive validity,[41,68] few, if any studies, have demonstrated these instruments to be predictive of the wide range of factors highlighted in this study. Although future investigations examining each of these instruments in a categorical manner would be welcomed and extremely valuable, the robust associations of MVAS scores with socioeconomic and psychosocial outcomes outlined in this study further validate the instrument as valuable to both researchers and clinicians alike. Consequently, more studies investing the validity of the

Table 8. Physical and Psychosocial Measures Based on Posttreatment MVAS Score (n = 1,562)

Variable	Zero (0)	Mild (1–40)	Moderate (41–70)	Severe (71–100)	Very Severe (101–130)	Extreme (131–150)	*P* Value (Linear Trend)
Cumulative score (PRE) (X, SD)	47 (17)	44 (17)	41 (16)	36 (15)	30 (15)	27 (9)	<0.001
Cumulative score (POST) (X, SD)	88 (21)	79 (16)	74 (16)	69 (15)	59 (17)	56 (17)	<0.001
BDI (PRE) (X, SD)	13 (10)	14 (10)	15 (9)	17 (10)	18 (11)	24 (13)	<0.001
BDI (POST) (X, SD)	1 (2)	4 (7)	8 (8)	12 (9)	16 (10)	25 (12)	<0.001
Pain intens. (PRE) (X, SD)	7.4 (1.8)	6.0 (3.9)	6.5 (2.0)	7.0 (3.6)	7.6 (1.7)	8.7 (5.0)	<0.001
Pain intens. (POST) (X, SD)	0.1 (0.5)	2.8 (3.2)	4.4 (1.5)	6.2 (3.9)	7.9 (5.2)	8.6 (1.2)	<0.001

MVAS, particularly in relation to the Oswestry and Roland–Morris, are encouraged and warranted.

This study's use and analysis of MVAS scores in a categorical manner also allows closer examination of the data produced, as well as transformation of such data into a useful clinical tool. There is precedent for organizing data in this categorical manner. Such organization of data into subgroups meets the need for classification of individuals. In clinical research, patients may form an amorphous group that resists description unless classified in some meaningful way. Clinicians benefit from this classification because it enables them to use diagnostic categories. One example is the classification of weight: the distinctions among anorexia, underweight condition, normal weight, overweight condition, obesity, and severe obesity are made according to the body mass index, which varies on a continuum. Also, there are numerous precedents of classification based on cutoff scores for psychological tests. For example, the Beck Depression Inventory scores appear on a continuum, which often is segmented according to some kind of predicted outcomes. The MMI subscales also are subjected to cutoffs to distinguish subgroups of patients.

Use of the MVAS to classify patients as severe, very severe, and extreme may raise a plethora of "red flags" with regard to the clinical outcome and "risk factors" of a particular patient. For example, if a patient has a score of 132 on the MVAS at pretreatment, then physicians, physical therapists, and psychologists each can implement strategies to keep the patient in the program. Levels can be assigned to disability risk. Scores of 71 to 100 may indicate a Level 1 risk, in which smaller and less drastic steps are taken to ensure that the patient is able to benefit maximally from the program. Scores of 101 to 130 may indicate a Level 2 risk, in which more involved measures can be taken by staff, and scores of 131 and above may indicate a Level 3 risk, signifying to all staff members that a patient is more vulnerable to a poor outcome.

Additionally, clinicians may benefit from administering a battery of physical and psychosocial tests to such patients at midtreatment, to allow for careful assessment of the at-risk patient's progress, or lack thereof, as the rehabilitation program proceeds. Regarding posttreatment scores, the patients still scoring in the severe, very severe, and extreme range might be offered some kind of "booster treatment," in which they return for 2- to 3-day periods at set intervals (possibly 3, 6, and 9 months) to receive additional information and encouragement, reminding them of the skills and exercises learned during treatment. Furthermore, as these patients are identified, the barriers to treatment they experience relative to other CMD patients can be more readily identified, allowing the clinical staff to adjust their treatment plans accordingly as they accumulate more knowledge about such patients over time. Of course, at this point in time, these potential clinical uses of such "risk cutoff scores" are merely speculative, and require future evaluation.

Overall, the categorical examination of MVAS scores presented in this study represents a unique manner way to use a self-report disability instrument. The strong associations between MVAS scores and a variety of outcome measures warrant further investigation of the MVAS, particularly with regard to how it compares with other measures when a categorical analysis is used. Not only will this further a better understanding about validity of such instruments in the literature, but it also will aid clinicians, who would benefit from the use of cutoff scores.[69]

■ Key Points

- Higher pretreatment MVAS scores were associated with a lower rehabilitation completion rate, higher levels of depression, and a higher rate of postrehabilitation health care utilization.
- Posttreatment MVAS scores were associated with lower rates of work return, work retention, financial settlement, and postrehabilitation surgery.
- This study demonstrates the effectiveness of using a simple measure of disability to recognize which patients may be at increased risk for poor treatment outcome.
- Increased use and investigation of the MVAS may be warranted given the strong indicators shown in this study.

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DATE:_____ NAME:_____

PLEASE MAKE AN "X" ALONG THE LINE TO SHOW HOW FAR FROM NORMAL TOWARD THE WORST POSSIBLE SITUATION YOUR PAIN PROBLEM HAS TAKEN YOU DURING THE PAST WEEK.

1. How bad is your pain?

no pain — worst possible

2. How bad is the pain at night?

no pain — worst possible

3. Does the pain interfere with your lifestyle?

no problem — total change in lifestyle

4. How good are pain killers for your pain?

complete relief — no relief

5. How stiff is your injured area?

no stiffness — worst possible stiffness

6. Does your pain interfere with walking?

no problem — cannot walk

7. Do you hurt when walking?

no pain — worst possible pain

8. Does your pain keep you from standing still?

can stand as long as I want — cannot stand at all

9. Does your pain keep you from twisting?

no problem — cannot twist

10. Does your pain allow you to sit in an upright hard chair?

sit as long as I like — cannot use a hard chair at all

11. Does your pain allow you to sit in a soft arm chair?

sit as long as I like — cannot use a soft chair at all

12. Does your injured body part hurt when lying in bed?

no pain — no relief at all

13. How much does your pain limit your normal lifestyle?

no limit — cannot do anything

14. Does your pain interfere with your activities of daily living or work?

no problem — major problem

15. How much have you had to change your home or work place activities because of pain?

no change — a great deal of change