Journal of Clinical Psychology in Medical Settings, Vol. 10, No. 4, December 2003 (© 2003)

Presurgical MMPI-2 Cluster Profiles Predict 1-Year Low-Back Surgery Outcomes[1]

Kevin S. Masters,[2,6] David S. Shearer,[2] Benjamin M. Ogles,[3] and Rand L. Schleusener[4,5]

The primary purpose of this study was to examine whether empirically derived cluster profiles based on scores from the Minnesota Multiphasic Personality Inventory-2 (MMPI-2) predicted outcomes of surgery at 1 year for patients with low-back pain. On the basis of hierarchical cluster analysis of presurgery MMPI-2 scores for 60 patients, three interpretable and significant subgroups were formed. These consisted of a pathological/neurotic type, a double V-code type, and a normal type. The patents in the normal type were significantly more likely to report beneficial outcomes of surgery in terms of disability and pain than those in the other 2 types. These findings extend previous research and suggest (1) low-back surgery candidates are heterogeneous in their psychological profiles, and (2) MMPI-2 profiles are predictive of low-back surgery outcome. Future research should focus on identifying physiological substrates for these distinct profiles and investigating the effectiveness of presurgical psychological interventions based on profile type.

KEY WORDS: MMPI-2; back pain; surgery; cluster analysis.

Low-back pain (LBP) is a significant health problem in the United States affecting approximately 12 million people annually (Cavanaugh & Weinstein, 1994) and causing a considerable burden on the U.S. health care system. Garofalo and Polatin (1999) referred to *low-back pain* as an "epidemic" in industrialized countries estimating that 80% of the population will experience LBP at some time. The financial obligation for LBP including medical and surgical expenses, lost productivity, and compensation costs runs in the tens of billions of dollars annually. Even more perplexing is the human cost. Although the vast majority of LBP sufferers recover completely in a relatively short-time period (Bigos et al., 1994; Deyo, 1998; Epker & Block, 2001) a small percent are left with intractable LBP.

Even though surgery is recommended only as a tertiary care procedure for the overwhelming majority of low-back conditions (Bigos et al., 1994) approximately 280,000 elective surgeries, of various types (e.g., spinal fusion, laminectomy/discectomy, spinal cord stimulation implantation), for LBP are performed each year in the United States (Taylor, Deyo, Cherkin, & Kreuter, 1994). Surgery for LBP, however, presents a number of complicating issues. For example, rates of surgery for LBP vary substantially among industrialized countries, among regions of the United States, and among small areas within states (Deyo, Cherkin, Conrad, & Volinn, 1991; Keller, Soule, Wennberg, & Hanley, 1990; Taylor et al., 1994; Volinn et al., 1992). This implies a lack of consensus regarding the criteria for who should undergo surgery. Further, studies on the outcomes of spinal surgery offer evidence of significant variability. In an

[1]An earlier version of this paper was presented at the 21st Annual Meeting of the Society of Behavioral Medicine, Nashville, Tennessee, April 2000.

[2]Department of Psychology, Utah State University, Logan, Utah.
[3]Department of Psychology, Ohio University, Athens, Ohio.
[4]Department of Orthopedic Surgery, University of Utah Medical Center, Salt Lake City, Utah.
[5]Present address: Black Hills Orthopedics, Rapid City, South Dakota.
[6]Correspondence should be addressed to Kevin S. Masters, PhD, Department of Psychology, 2810 Old Main Hill, Utah State University, Logan, Utah 84322-2810; e-mail: kevin.masters@usu.edu.

1068-9583/03/1200-0279/0 © 2003 Plenum Publishing Corporation

often-cited report, Turner et al. (1992) conducted a meta-analysis of spinal fusion outcome studies spanning 1966–91. They reported an average of 68% satisfactory outcomes with a range from 16 to 95%. Hoffman, Wheeler, and Deyo (1993) similarly reported, in a review of laminectomy/discectomy procedures, a mean success rate of 67%. Although surgical and other techniques for treating LBP continue to evolve, Mooney (2000) recently stated that, eventually, they all seem to present about a two out of three chance for improvement. This means that one third of the people who undergo these procedures are left either unimproved or deteriorated. Many of these individuals have reoperation, despite findings suggesting that increasing number of surgeries correlates with increasing likelihood of poor outcomes (Ciol, Deyo, Kreuter, & Bigos, 1994; DeBerard, Masters, Colledge, Schleusener, & Schlegel, 2001; Waddell, 1987). Clearly it is important to be able to better predict who, among those with intractable LBP, will benefit from surgery (DeBerard et al., 2001; Frymoyer, 2001).

The original MMPI has a long and somewhat controversial history of use with chronic pain populations including those with LBP (Bradley, 1995; Keefe, Lefebvre, & Beaupre, 1995; Main & Spanswick, 1995; Sanders, 1995; Trief, Grant, & Fredrickson, 2000; Turk & Fernandez, 1995). Although initial efforts focused on identifying a "pain profile" subsequent investigations established that patients with chronic pain are represented on the MMPI by three to four different subgroups (see Weisberg & Keefe, 1999, for a review). These subgroups have been used to compare outcomes for various LBP treatment programs. Generally it has been found that there is a relationship between MMPI profile groups and treatment outcomes for conservative treatments.

Several investigators (Doxey, Dzioba, Mitson, & Lacroix, 1988; Dzioba & Doxey, 1984; Herron & Pheasant, 1982; Herron, Turner, Clancy, & Weiner, 1986; Kuperman, Osmon, Golden, & Blume, 1979; Long, 1981; Oostdam & Duivenvoorden, 1983; Oostdam, Duivenvoorden, & Pondaag, 1981; Pheasant, Gilbert, Goldfarb, & Herron, 1979; Spengler, Freeman, Westbrook, & Miller, 1980; Turner & Leiding, 1985; Watkins, O'Brien, Draugelis, & Jones, 1986) have examined relations between the MMPI and back surgery outcomes. In general these studies conclude that elevations on scales Hs, Hy, and D, in that order, predict worse surgical outcomes. Though providing an empirical beginning for establishing the use of the MMPI in presurgical contexts, these studies are hampered by a variety of methodological concerns. The problems of specific studies vary but as a group they include reliance on single scale MMPI interpretations, utilization of retrospective designs, failure to include MMPI validity scales in data analysis, and incorporation of personality profiles (when used at all) on the basis of a priori configurations. Of course all of these studies used the MMPI rather than the MMPI-2. Although the MMPI-2 is based on the original, many changes, including the basis for determining *t* scores, were made. Studies have shown that congruence rates between these instruments vary considerably on the basis of a number of factors (see Graham, 2000, for a review of these issues). Specific to chronic pain populations, Keller and Butcher (1991) found that classification, based on both MMPI and MMPI-2 norms, into cluster groups identified by Costello, Hulsey, Schoenfeld, and Ramamurthy (1987) resulted in differences in the frequency distribution for the cluster groups, particularly for male participants. Overall, however, these authors suggest that MMPI and MMPI-2 profiles lead to similar interpretations. Strassberg (1991; Strassberg, Tilley, Bristone, & Oei, 1992) concluded that relations between MMPI and MMPI-2 T scores are complex and difficult to predict. Given these findings and that the MMPI-2 has become the standard in clinical practice, it seems prudent to conduct research with the new instrument to determine its effectiveness as a predictor of surgical outcome.

Riley, Robinson, Geisser, Wittmer, and Smith (1995) produced the first study to do this. They improved on previous efforts by using the MMPI-2 and identifying subgroups through cluster analytic techniques. Initially (Riley, Robinson, Geisser, & Wittmer, 1993) four stable clusters were formed: (1) within normal limits (WNL); (2) depressed–pathological; (3) neurotic triad; and (4) conversion V-type; that closely resembled those identified earlier by Costello et al. (1987) on the original MMPI. Subsequently it was determined that those individuals exhibiting the WNL and triad profiles had better spinal fusion outcomes than did those demonstrating the other two types. The findings regarding the triad profile were somewhat surprising because results from the single scale elevation studies suggested worse outcomes for those with elevations on these scales. Thus it is possible that the multivariate clusters provided additional information not found in the single scale studies. Further, interpretation of the MMPI-2 in clinical practice usually focuses on analysis of scale score patterns more closely in keeping with the multivariate approach. Clearly

Riley and colleagues' study presents a significant advance in the research literature although it does have limitations. For example, the sample of patients is restricted to those undergoing one specific surgery (i.e., spinal fusion) by one surgeon. The outcome and presurgical assessments were made at various points across time but were not consistent and, with the exception of the Stauffer–Coventry Index (SCI), were based on use of nonstandardized single-item questions. Further, no study to date has estimated effect sizes relative to MMPI-2 profile comparisons.

This study was conducted to extend the research regarding the ability of the MMPI-2 to predict surgical outcomes among patients with LBP and offers several advances of the Riley et al. (1995) study. First, multivariate cluster analytic techniques were used to determine cluster constellations, however new to this study, both validity and clinical scales of the MMPI-2 were included in these calculations. Second, the study utilizes a prospective design with collection of both presurgery information and postsurgery outcome data at specific and consistent time intervals, an advance over the procedures used in Riley et al. Third, patients included in the study underwent spinal surgeries other than fusion, thus extending the research to a broader range of surgical procedures. Fourth, data were collected at two medical centers and included patients from six different surgeons. Finally, multiple standardized and validated measures of surgery outcome were included and comparisons were made not only using traditional statistical significance criteria but also including estimates of effect size. It was predicted that interpretable MMPI-2 cluster types would be identified and that these would differ with respect to surgical outcome.

METHOD

Participants

Sixty patients with LBP who were awaiting surgery at either a major university medical center or a community hospital in the western United States were initially recruited to participate in the study. They ranged in age from 19 to 81 years ($M = 45.98$; $SD = 13.53$) and 53% were female. Ninety percent were Caucasian, 3% American Indian, 3% Hispanic, and 3% did not report ethnicity. Participants' highest level of completed formal education ranged from "some high school" to completion of a "master's degree" with 71% having between a high school diploma and a 2-year college degree. Their average number of months with LBP prior to surgery ranged from 2 to 468 with a median of 30. For 69% of them this would be their first surgery, 14% were having their second, and 17% their third.

Eighteen participants who began the study and completed presurgical assessments were unavailable for outcome measurement at the 1-year follow-up. The reasons for attrition were as follows: could not contact ($n = 12$), had fusion surgery subsequent to initial procedure ($n = 2$), and did not have surgery ($n = 4$). There were no significant differences between those who dropped out and those remaining in the study on all demographic variables, months in LBP, number of previous surgeries, and initial assessment on the Back Pain Questionnaire (BPQ) and Disability Questionnaire. Data regarding comparisons of the dropouts on the MMPI-2 are presented below.

Measures

Demographic and Background Questionnaire

Participants were asked to provide their age, sex, marital status, occupation, ethnic status, level of education, length of time experiencing LBP, and number of previous low-back surgeries.

MMPI-2

The MMPI-2 is a well-known and widely used psychological test consisting of 567 true–false items. It traditionally yields scores on 4 validity scales and 10 clinical scales although numerous other scales may be scored. For this study only the standard validity and clinical scales were analyzed. Detailed information on the MMPI-2 is widely available from a number of sources including Graham (2000) and the MMPI-2 manual (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989).

Back Pain Questionnaire

The BPQ was developed to measure effectiveness of intervention with LBP patients (Million, Hall, Haavik Nilsen, Baker, & Jayson, 1982). It consists of 15 questions that require patients to rate their current level of pain in a variety of settings and activities (e.g., when lying down, walking, standing, sitting in an upright hard chair) and the effect of pain on lifestyle

and functional abilities. On the original instrument a visual analogue scale was used for item response, however, to accommodate the telephone follow-up interview used in this study the scale was adapted to a 7-point Likert-type format. This format was used at both presurgery and follow-up assessments. The anchors and all items remained the same as in the original analogue version. Ratings on individual items are combined to form a global index of subjective LBP. Test–retest reliability has been reported at .96 by the test authors and they also demonstrated that the instrument is sensitive to treatment-induced change.

Disability Questionnaire

The DQ was developed to measure self-report disability due to LBP (Roland & Morris, 1983a). It consists of 24 true–false statements about the patient's current (i.e., today) disability status resulting from back pain and covering a variety of daily living activities including, but not limited to, walking, kneeling/bending, turning over in bed, getting out of a chair, and getting dressed. An overall disability score is derived by totaling the number of responses endorsed by the participant. The authors report a test-retest reliability (within the same day) coefficient of .91. Construct validity has been supported by showing the instrument's sensitivity to improvement over time with acute LBP (Deyo, 1986; Roland & Morris, 1983a, 1983b) and to improvement with treatment of LBP (Klein & Eek, 1990).

Stauffer–Coventry Index

The SCI (Stauffer & Coventry, 1972) provides a clinical measure of surgical outcome. It has been widely used in studies of LBP surgical outcome (e.g., Boos, Marchesi, & Aebi, 1991, 1992; Oostdam et al., 1981; Oostdam & Duivenvoorden, 1983; Uomoto, Turner, & Herron, 1988) and was incorporated in studies similar to the one presented here (Riley et al., 1995; Turner, Herron, & Weiner, 1986). The measure is designed for postsurgery administration and consists of three multiple response self-report questions regarding pain reduction, return to work, and limitations of physical activities. Patient scores are assigned to categories (good, fair, poor) based on the most severe rating, creating a conservative but clinically important index. Specifically the categories are as follows: (1) Good—76–100% relief in leg and back pain, return to previous work status, minimal or no restriction of physical activities; (2) Fair—26–75% relief of leg and back pain, return to lighter work, moderate restrictions of physical activities; and (3) Poor—0–25% relief of leg and back pain, no return to work following surgery, severe restrictions of physical activities.

Rating of Satisfaction With Surgery

Participants rated their level of satisfaction with the surgery on a scale ranging from 0 (*totally unsatisfied*) to 10 (*totally satisfied*).

Procedures

Consecutive patients were invited to participate in the study by a nurse during their regularly scheduled appointment 1-week prior to surgery. After agreeing to enter the study a time was arranged to administer the background questionnaire, MMPI-2, BPQ, and DQ. The decision to provide surgery was unrelated to participation in this study and made by the participating surgeons and patients according to their regular practice. Those who collected the data were not involved with the patients' treatment or surgery and surgeons were blind to presurgical research data. Upon arrival for the testing session participants first signed an IRB approved informed consent statement. They were then administered the paper–pencil tests in a private room at each respective hospital. Participants accompanied by relatives or friends were asked to have them wait outside and instructed to complete all items without assistance. Participants were also informed that they would be contacted by telephone for follow-up data collection. Upon completion of the presurgical testing each participant was thanked and paid for their participation in the study. One year following surgery 42 participants were successfully contacted by telephone and completed the surgery outcome assessments, that is, the BPQ, DQ, SCI, and rating of satisfaction with surgery. Items and response alternatives were read to patients verbatim.

RESULTS

Cluster Solutions

Cluster analysis using Ward's method with squared Euclidian distance as the measure of proximity between pairs was performed on the MMPI-2

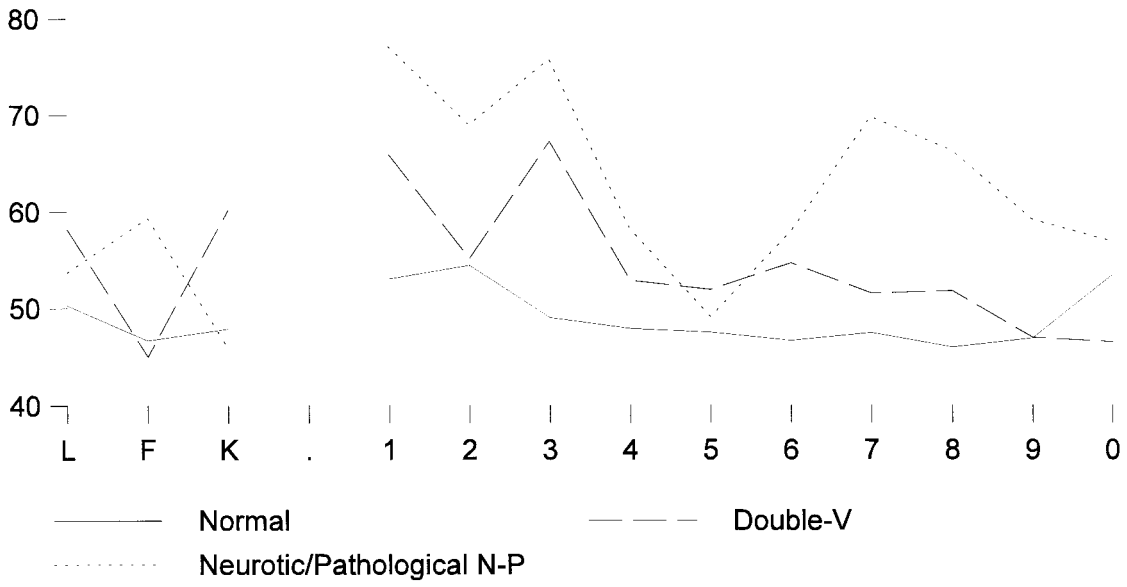

Fig. 1. MMPI-2 mean profiles of validity and clinical scales for clusters.

scale scores for the original 60 participants. To determine the number of clusters that best fit the analysis, examination of a scree plot of the percent change in the fusion coefficient as presented in the agglomeration schedule was performed. The fusion coefficient increases as the number of groups in the cluster analysis decreases. Examination of the scree plot indicated that a four-cluster solution was possible. However, clusters 3 and 4 were, based on MMPI-2 interpretations, essentially the same. Thus, on the basis of ease in interpretation and adequate number of patients per cluster, the three-cluster solution was determined to be the best and most parsimonious fit for interpreting the cluster results.

Mean *t* score values of the validity and clinical scales for the MMPI-2 clusters are plotted in Fig. 1. The first cluster was named "normal" and consists of a profile in which all of the clinical and validity scales are within normal limits. The second cluster was called "double-V." It is characterized by a V-shaped profile among the validity scales and portrays the classic "conversion V" profile on the clinical scales, that is, elevations on scales 1 and 3. All other scales are within normal limits. The final cluster was termed *neurotic/pathological* (N-P) as it is characterized by more extreme elevations on clinical scales 1 and 3 along with significant elevations on scales 2, 7, and 8. The validity scale mean scores suggest the N-P profile is valid though it could be indicative of individuals having difficulty in one particular area of life.

Comparisons prior to surgery between the three clusters that both included and excluded subsequent study dropouts for age, sex, marital status, level of education, length of time experiencing LBP, number of previous low-back surgeries, and scores on the BPQ and DQ all revealed no significant differences. This suggests that members of distinct clusters were not likely to have differentially more serious nonpsychological risk factors that have been identified in previous studies to predict poor surgical outcomes (cf. DeBerard et al., 2001; Franklin, Haug, Heyer, McKeefrey, & Picciano, 1994; Trief et al., 2000) and it also indicates that they were not reporting different levels of pain and functional disability.

Because 18 participants were not available for the 1-year follow-up, a chi-square comparing those present at follow-up with those absent was calculated to determine if there was differential dropout based on MMPI-2 cluster membership. The test was not significant, $\chi^2(2, N = 60) = 4.06$, $p > .05$, indicating no statistical evidence of differential drop-out based on cluster membership.

Outcome of Surgery

To examine how patient response to surgery differed across the MMPI-2 clusters a multivariate analysis of variance (MANOVA) was calculated with cluster membership serving as the independent

Table I. Means and Standard Deviations on the 1-Year Postsurgery BPQ and DQ Scores for Each MMPI-2 Cluster

	BPQ[1]		DQ	
MMPI-2 cluster	Mean	*SD*	Mean	*SD*
Normal	93.73	8.65	2.55	4.18
Double-V	100.88	11.75	9.18	7.31
N-P	106.81	11.23	11.33	7.52

[a]Scoring for the BPQ followed procedures presented by Million et al. (1982) except that observed item scores were based on the Likert format rather than visual analogue measures. Standardization of item scores following Million et al. was done. A constant of 100 was added to each total score to eliminate negative numbers.

variable and 1-year follow-up scores on the BPQ and DQ serving as the dependent measures. Overall the MANOVA indicated significant effects for the MMPI-2 clusters, $F(4, 76) = 3.12$, $p < .05$. Inspection of univariate analyses showed significant findings on both the BPQ, $F(2, 39) = 3.62$, $p < .05$, and DQ, $F(2, 39) = 5.10$, $p < .01$. Comparison of specific contrasts using the Tukey procedure demonstrated that for the BPQ the normal cluster differed from the N-P cluster. On the DQ the normal cluster differed from both the N-P and the double-V clusters (see Table I). In each case the normal MMPI-2 cluster portrayed the best surgical results.

Another useful way to analyze these results is to examine the respective effect size comparisons between cluster groups on the outcome measures. These data provide an estimate of the power or magnitude of the effect independent of sample size or specific unit of measurement. Cohen (1988, 1992) has provided formulas for calculating effect sizes and developed conventions for interpreting the magnitude of these effects. On the basis of these conventions, small effects are those between .20 and .49, medium effects are found from .50 to .79, and large effects are .80 or greater. To put this in perspective, a medium effect characterizes one likely to be visible to the naked eye of a careful observer. For the BPQ the effect size in the comparison between the N-P cluster and the normal cluster was 1.12 (large). The other two comparisons, that is, double-V versus normal and double-V versus N-P, were 0.55 and 0.58, respectively, both indicating medium effects. On the DQ the comparisons involving the normal group were both large, that is, normal versus N-P = 1.28 and normal versus double-V = 0.96. The comparison between the double-V and N-P groups was small (.33).

To determine if there were cluster differences in surgical outcomes as determined by the SCI classifications, a 3 (outcome classification) × 3 (cluster profile) chi-square was calculated (see Table II). The results were significant, $\chi^2(4, N = 42) = 9.52$, $p < .05$. Inspection of Table II reveals an interesting pattern of findings. None of the individuals exhibiting the N-P cluster had a good SCI outcome and, alternatively, none of those with the normal cluster had a poor SCI outcome. These findings, taken with those above, indicate that better surgical outcomes were significantly more likely among those with normal presurgical MMPI-2 profiles than among those with the N-P profile. The double-V profile tended to score in-between the others.

Table II. Number of Patients Classified in Each SCI Level at 1-Year Postsurgery Based on MMPI-2 Cluster

	SCI classification		
MMPI-2 cluster	Good	Fair	Poor
Normal	6	5	0
Double-V	6	10	6
N-P	0	7	2

Satisfaction With Surgery

Although measures of surgical outcome differed among the three clusters, findings for self-reported satisfaction with surgery only approached significance, $F(2, 39) = 3.08$, $p = .057$. All three groups endorsed relative satisfaction with their surgery as demonstrated by their overall mean ratings: normal cluster, $M = 9.45$ ($SD = 1.21$); double-V cluster, $M = 6.59$ ($SD = 3.85$); N-P cluster, $M = 8.33$ ($SD = 3.20$).

DISCUSSION

The general purposes of this study were (1) to establish through the use of multivariate cluster analytic techniques MMPI-2 cluster types among patients awaiting surgery for LBP and (2) to determine if these cluster types differ regarding surgical outcomes for LBP at 1 year. Both objectives were met.

MMPI-2 Cluster Profiles

With regard to the cluster profiles, the findings of this study are similar, though not identical, to previous investigations. Many investigators who have

used multivariate clustering procedures have found four distinct clusters (Bradley & Van der Heide, 1984; Costello et al., 1987; Guck, Meilman, Skultety, & Poloni, 1988; Hart, 1984; McGill, Lawlis, Selby, Mooney, & McCoy, 1983; Riley et al., 1995) whereas others (e.g., Armentrout, Moore, Parker, Hewett, & Feltz, 1982; Keller & Butcher, 1991; Strassberg et al., 1992), including the present study, identified three cluster patterns. Regarding these differences a couple of points are worth noting. First, only the study by Riley et al. utilized the MMPI-2. As indicated, although the original and MMPI-2 are similar in terms of item format and content, scoring, etc., for a variety of reasons (e.g., new normative sample, item editing, use of normalized *T* scores) differences between profiles of individuals taking both tests would, potentially, be expected. Similarly, these differences could impact the results of statistical clustering techniques. Second, many of the previous studies used patients in chronic pain programs many of whom did not have LBP. It is possible that patients experiencing other types of pain differ enough in their MMPI-2 profiles from presurgical LBP patients to produce slightly different cluster results. Nevertheless, it is the similarity of the findings, rather than the differences, that is most striking. The cluster profiles found in this study are quite similar to those of Riley and colleagues. Both studies depict within normal limits and V-type groups. The N-P group in this study is a combination of Riley's neurotic triad and depressed/pathological groups. However, in their surgery outcome study the depressed/pathological group consisted of only 4 patients out of a total sample of 71.

MMPI-2 Profiles and Surgical Outcomes

Many studies have demonstrated that psychosocial factors are important considerations for low-back and other surgery outcomes (cf. Block, 1999; Devine, 1992; Epker & Block, 2001; Johnston & Vögele, 1993; Kiecolt-Glaser, Page, Marucha, MacCallum, & Glaser, 1998; Trief et al., 2000). The present study demonstrated that MMPI-2 profiles determined on the basis of multivariate cluster analysis differed on low-back surgical outcomes at 1 year. The normal MMPI-2 profile cluster obtained the best results. Interestingly, the Riley et al. (1995) study did not find differences between the normal profile and the Triad, whereas the current study did find differences between the normal cluster and the N-P cluster on all variables.

By way of explanation, it should be noted that the Triad and N-P profiles are not identical. Both are characterized by elevations on scales 1, 2, and 3, but the N-P profile also shows significant elevations (i.e., above a *t* score of 65) on scales 7 ($t = 69.71$) and 8 ($t = 66.24$) whereas the Triad does not. Although the shape of the two profiles is extremely similar, the major discrepancy between them is the approximately 10 *t* score point differences in elevation on scales 7 and 8. Further, Riley et al. (1995) noted that their Triad profile tended to demonstrate better results than did the V-type cluster. The current study, on the other hand, found the double-V type obtaining generally better outcomes than the N-P. Differences between the studies may help explain these findings. For example, Riley et al. used three subjective, self-report, single-item measures of outcome at various intervals whereas the current study used multiple-item standardized self-report measures of outcome at 1 year. Further, among their sample of spinal fusion patients, none achieved a good outcome on the SCI. By contrast, 12 (28.5%) in the current sample of laminectomy/discectomy patients obtained good SCI results. Thus, discrepancies in outcome measures, type of patients, and surgical procedures may account for at least some of the incongruities.

Important questions remain, however. For example, to what extent and in what direction does relative elevation on MMPI-2 scale 2, as compared to scales 1 and 3, relate to differential outcome? Riley et al. (1995) and Long (1981) indicated that when scale 2 is elevated along with scales 1 and 3 a reactive depression to the incident of LBP may be indicated offering a more favorable surgical prognosis than when scale 2 is not elevated with scales 1 and 3 (conversion V profile). The present findings did not support this conclusion. Nevertheless, the issue of reactive depression is worth consideration. Block (1999) and Block and Callewart (1999) noted that a depression that is reactive may portend more favorable outcomes on the basis of signaling better characterological or long-term life adjustment. It is possible that the magnitude of elevation on scale 2 is of less importance than the type of depression that it signifies. Thus, different studies may demonstrate varying relations between scale 2 and outcomes for this reason.

Pre-surgical MMPI-2 data may be thought of as a combination of both characterological or long-term personality attributes and short-term responses to LBP that include emotional, cognitive coping, and behavioral factors. Just as the N-P profile in this study may indicate long-term difficulties, it may also

indicate a short-term plea for help indicative of the presence of less successful specific LBP coping strategies. In fact, analysis of the validity scores for this profile, along with consideration of other presurgical data, suggest the latter may be the case. Perhaps the best understanding of the individuals demonstrating the N-P profile is that they are experiencing increased emotional difficulty managing their current LBP. This may or may not be indicative of long-term coping problems, but certainly suggests that emotional factors are compromising their coping abilities and are likely to interfere with surgical recovery.

The double-V profile is also of interest. We chose to title this the double-V rather than simply V-type to emphasize that the V configuration was found on the L, F, K validity scales as well as on clinical scales 1, 2, and 3. The proper interpretation of this profile (i.e., the V on scales 1, 2, and 3) among patients with chronic pain has been debated. Costello et al. (1987) found that this profile lacked consistent correlates but tended to intermediate between the normal and N-P groups (using the nomenclature from the present study). Bradley, Prokop, Margolis, and Gentry (1978) suggested that those with clinical elevations on scales 1/3 utilized the sick role to meet emotional needs and others have argued that the scales signify dependency and somatization. Some have argued that because scales 1 and 3 contain many items describing somatic complaints, they are susceptible to elevation simply as a result of physical infirmity and therefore these elevations are meaningless from a psychological standpoint. Nevertheless, clinical elevations on scales 1 and 3 have been consistently related to poor conservative treatment outcomes and the studies by Long (1981) and Riley et al. (1995) and the present investigation all show worse outcomes for a variety of low-back surgeries among patients characterized by this profile.

To help clarify the clinical significance of these scales, three considerations are important. First, Keefe et al. (1995) recommend consideration of Harris–Lingoes subscales to better determine the factors responsible for the 1/3 elevations. Second, the magnitude of the elevation should be considered. The higher the magnitude, the more confidence one may have that psychological factors are important regarding the patient's condition and thus may complicate outcomes. Finally, the validity scales should also be considered. Not all studies finding the 1/3 pattern on the clinical scales found the same validity scale pattern. In the present investigation the validity scales demonstrated a V profile of their own. This double-V profile was previously shown to link with secondary gain influences among patients being treated at an outpatient spine clinic (Masters, 1996). Similarly, Hart (1984) noted that those with this validity and clinical profile may present themselves as being morally virtuous and lacking normal weaknesses while at the same time using somatic symptoms to gratify dependency needs.

Finally, to the extent that the factors responsible for producing both the double-V and N-P profiles and worse surgical results can be therapeutically altered, efforts in this direction should be made. Several reviews (Contrada, Leventhal, & Anderson, 1994; Johnston & Vögele, 1993; Mumford, Schlesinger, & Glass, 1982) have reported rather dramatic positive results for presurgical psychological interventions that have been minimal in terms of their staff and financial demands. This area of practice needs further investigation. For example, studies in which surgical candidates are screened with MMPI-2 assessment and then, based on their profiles, entered into brief presurgery intervention need to be undertaken. A previous investigation (DeBerard, Masters, Colledge, Schleusener, & Schlegel, 2002) suggested that presurgical psychological evaluations as conducted in actual practice, may not serve their intended purpose of improving surgical results. Increased use of presurgical interventions may improve this state of practice.

Limitations and Future Research

This study is limited by the moderately small number of participants. The sample size may have contributed to the finding of three as opposed to four clusters. The reliance on self-report indicators of outcome could be a concern to readers who prefer physiologically based measures such as readings from MRI. Nevertheless, subjective evaluations are important. What surgical patient would settle for a successful MRI accompanied by continued pain and disability? For that matter, what employer would settle for this finding among his/her employees? Yet, this is sometimes the case. Research on spinal fusion indicates that rates of arthrodesis (solid fusion) correlate only mildly with self-report and behavioral indicators of surgical outcome (DeBerard et al., 2001). Kaplan (1990) has argued convincingly for the importance of behavioral and quality of life indicators as measures of medical outcomes.

Several prospects for future research are evident from these findings. First, replication is necessary including use of larger samples obtained from

geographically diverse areas and treated by many surgeons. This is particularly appropriate, given the diverse rates of back surgery found in different geographical areas. Studies are also needed that not only identify psychological and behavioral correlates of the MMPI-2 cluster profiles among low-back surgery candidates but also identify related physiological substrates that may interfere with surgical success (cf. Kiecolt-Glaser et al., 1998). Finally, presurgical intervention studies that screen patients on the basis of their MMPI-2 profiles and then offer cost-effective interventions need to be conducted to determine if the surgical results for those at risk can be improved.

ACKNOWLEDGMENTS

This research was supported by a faculty research grant from Utah State University. The authors thank Edward M. Heath, PhD, for his thoughtful comments on an earlier version of this paper.

REFERENCES

Armentrout, D. P., Moore, J. E., Parker, J. C., Hewett, J. E., & Feltz, C. (1982). Pain-patient MMPI subgroups: The psychological dimensions of pain. *Journal of Behavioral Medicine*, *5,* 201–211.

Bigos, S., Bowyer, O., Braen, G., Brown, K., Deyo, R., & Haldeman, S. (1994). *Acute Low-back problems in adults. Clinical practice guidelines no. 14.* (AHCPR publication no. 95-0642). Rockville, MD: U.S. Department of Health and Human Services.

Block, A. R. (1999). Presurgical psychological screening in chronic pain syndromes: Psychosocial risk factors for poor surgical results. In R. J. Gatchel & D. C. Turk (Eds.), *Psychosocial factors in pain: Critical perspectives* (pp. 390–400). New York: Guilford.

Block, A. R., & Callewart, C. (1999). Surgery for chronic spine pain: Procedures for patient selection and outcome enhancement. In A. R. Block, E. F. Kremer, & E. Fernandez (Eds.), *Handbook of pain syndromes*: *Biopsychosocial perspectives* (pp. 191–212). Mahwah, NJ: Erlbaum.

Boos, N., Marchesi, D., & Aebi, M. (1991). Treatment of spondylolysis and spondylolysthesis with Cotrel–Dubousset instrumentation: A preliminary report. *Journal of Spinal Disorders*, *4,* 472–479.

Boos, N., Marchesi, D., & Aebi, M. (1992). Survivorship analysis of pedicular fixation systems in the treatment of degenerative disorders of the lumbar spine: A comparison of Cotrel–Dubousset instrumentation and the AO internal fixator. *Journal of Spinal Disorders*, *5,* 403–409.

Bradley, L. A. (1995). Biopsychosocial model and the Minnesota Multiphasic Personality Inventory: Even psychologists make cognitive errors. *Pain Forum*, *4,* 97–100.

Bradley, L. A., Prokop, C. K., Margolis, R., & Gentry, W. D. (1978). Multivariate analyses of the MMPI profiles of low-back pain patients. *Journal of Behavioral Medicine*, *1,* 253–272.

Bradley, L. A., & Van der Heide, L. H. (1984). Pain-related correlates of MMPI profile subgroups among back pain patients. *Health Psychology*, *3,* 157–174.

Butcher, J. N., Dahlstrom, W. G., Graham, J. R., Tellegen, A., & Kaemmer, B. (1989). *Manual for administration and scoring: MMPI-2.* Minneapolis: University of Minnesota Press.

Cavanaugh, J. M., & Weinstein, J. N. (1994). Low-back pain: Epidemiology, anatomy and neurophysiology. In P. D. Wall & R. Melzack. (Eds.), *Textbook of pain* (pp. 441–456). Edinburgh, NY: Churchill Livingston.

Ciol, M. A., Deyo, R. A., Kreuter, W., & Bigos, S. J. (1994). Characteristics in medicare beneficiaries associated with reoperation after lumbar spine surgery. *Spine*, *19,* 1329–1334.

Cohen, J. C. (1992). A power primer. *Psychological Bulletin*, *112,* 155–159.

Cohen, J. C. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Contrada, R. J., Leventhal, E. A., & Anderson, J. R. (1994). Psychological preparation for surgery: Marshaling individual and social resources to optimize self-regulation. In S. Maes, H. Leventhal, & M. Johnston (Eds.), *International review of health psychology* (Vol. 3, pp. 219–266). New York: Wiley.

Costello, R. M., Hulsey, T. L., Schoenfeld, L. S., & Ramamurthy, S. (1987). P-A-I-N: A four cluster MMPI typology for chronic pain. *Pain*, *30,* 199–209.

DeBerard, M. S., Masters, K. S., Colledge, A. L., Schleusener, R. L., & Schlegel, J. D. (2001). Outcomes of posterolateral lumbar fusion in Utah patients receiving workers' compensation. *Spine*, *26,* 738–747.

DeBerard, M. S., Masters, K. S., Colledge, A. L., Schleusener, R. L., & Schlegel, J. D. (2002). Pre-surgical psychological screenings for lumbar fusion: look at real world practice. *Psychology, Health and Medicine*, *7,* 411–424.

Devine, E. C. (1992). Effects of psychoeducational care for adult surgical patients: A meta-analysis of 191 studies. *Patient Education and Counseling*, *19,* 129–142.

Deyo, R. A. (1986). Comparative validity of the Sickness Impact Profile and shorter scales for functional assessment in low-back pain. *Spine*, *11,* 951–954.

Deyo, R. A. (1998). low-back pain. *Scientific American*, *279,* 48–53.

Deyo, R. A., Cherkin, D., Conrad, D., & Volinn, E. (1991). Cost, controversy, crisis: Low back pain and the health of the public. *Annual Review of Public Health*, *12,* 141–156.

Doxey, N. C. S., Dzioba, R. B., Mitson, G. L., & Lacroix, J. M. (1988). Predictors of outcome in back surgery candidates. *Journal of Clinical Psychology*, *44,* 611–622.

Dzioba, R. B., & Doxey, M. C. (1984). A prospective investigation into the orthopaedic and psychologic predictors of outcome of first lumbar surgery following industrial injury. *Spine*, *9,* 614–623.

Epker, J., & Block, A. R. (2001). Presurgical psychological screening in back pain patients: A review. *The Clinical Journal of Pain*, *17,* 200–205.

Franklin, G. M., Haug, J., Heyer, N. J., McKeefrey, S. P., & Picciano, J. F. (1994). Outcome of lumbar fusion in Washington State workers' compensation. *Spine*, *19,* 1897–1903.

Frymoyer, J. (2001). Point of view. *Spine*, *26,* 747.

Garofalo, J. P., & Polatin, P. (1999). low-back pain: An epidemic in industrialized countries. In R. J. Gatchel & D. C. Turk (Eds.), *Psychosocial factors in pain: Critical perspectives* (pp. 164–174). New York: Guilford.

Graham, J. R. (2000). *MMPI-2 assessing personality and psychopathology* (3rd ed.). New York: Oxford.

Guck, T. P., Meilman, P. W., Skultety, F. M., & Poloni, L. D. (1988). Pain–Patient Minnesota Multiphasic Personality Inventory (MMPI) subgroups: Evaluation of long-term treatment outcome. *Journal of Behavioral Medicine*, *11,* 159–169.

Hart, R. R. (1984). Chronic pain: Replicated multivariate clustering of personality profiles. *Journal of Clinical Psychology*, *40,* 129–133.

Herron, L. D., & Pheasant, H. C. (1982). Changes in MMPI profiles after low-back surgery. *Spine*, *7,* 128–133.

Herron, L. D., Turner, J., Clancy, S., & Weiner, P. (1986). The differential utility of the MMPI: A predictor of outcome in lumbar laminectomy for disc herniation versus spinal stenosis. *Spine*, *11,* 847–850.

Hoffman, R. M., Wheeler, K. J., & Deyo, R. A. (1993). Surgery for herniated lumbar discs: A literature synthesis. *Journal of General Internal Medicine*, *8,* 487–496.

Johnston, M., & Vögele, C. (1993). Benefits of psychological preparation for surgery: A meta-analysis. *Annals of Behavioral Medicine*, *15,* 245–256.

Kaplan, R. M. (1990). Behavior as the central outcome in health care. *American Psychologist*, *45,* 1211–1220.

Keefe, F. J., Lefebvre, J. C., & Beaupre, P. M. (1995). The Minnesota Multiphasic Personality Inventory in chronic pain: Security blanket or sound investment? *Pain Forum*, *4,* 101–103.

Keller, L. S., & Butcher, J. N. (1991). *Assessment of chronic pain patients with the MMPI-2.* Minneapolis, MN: University of Minnesota Press.

Keller, R. B., Soule, D. N., Wennberg, J. E., & Hanley, D. F. (1990). Dealing with geographic variations in the use of hospitals: The experience of the Maine medical assessment foundation orthopaedic study group. *Journal of Bone and Joint Surgery*, *72A,* 1286–1293.

Kiecolt-Glaser, J. K., Page, G. G., Marucha, P. T., MacCallum, R. C., & Glaser, R. (1998). Psychological influences on surgical recovery: Perspectives from psychoneuroimmunology. *American Psychologist*, *53,* 1209–1218.

Klein, R. G., & Eek, B. C. (1990). low-energy laser treatment and exercise for chronic low-back pain: Double-blind controlled trial. *Archives of Physical and Medical Rehabilitation*, *71,* 34–37.

Kuperman, S. K., Osmon, D., Golden, C. J., & Blume, H. G. (1979). Prediction of neurosurgical results by psychological evaluation. *Perceptual and Motor Skills*, *48,* 311–315.

Long, C. J. (1981). The relationship between surgical outcome and MMPI profiles in chronic pain patients. *Journal of Clinical Psychology*, *37,* 744–749.

Main, C. J., & Spanswick, C. C. (1995). Personality assessment and the Minnesota Multiphasic Personality Inventory 50 years on: Do we still need our security blanket? *Pain Forum, 4,* 90–96.

Masters, K. S. (1996, April). *The MMPI and financial gain among back patients: Fake good to seem bad.* Paper presented at the annual convention of the Rocky Mountain Psychological Association, Park City, UT.

McGill, J. C., Lawlis, G. F., Selby, D., Mooney, V., & McCoy, C. E. (1983). The relationship of Minnesota Multiphasic Personality Inventory (MMPI) profile clusters to pain behaviors. *Journal of Behavioral Medicine*, *6,* 77–92.

Mooney, V. (2000, November). *Current concepts of low-back pain treatment.* Paper presented at the annual meeting of the Utah Spine Forum, Salt Lake City, UT.

Million, R., Hall, W., Haavik Nilsen, K., Baker, R. D., & Jayson, M. I. V. (1982). Assessment of the progress of the back-pain patient. *Spine*, *7,* 204–212.

Mumford, E., Schlesinger, H. J., & Glass, G. V. (1982). The effects of psychological intervention on recovery from surgery and heart attacks: An analysis of the literature. *American Journal of Public Health*, *72,* 141–151.

Oostdam, E. M. M., & Duivenvoorden, H. J. (1983). Predictability of the result of surgical intervention in patients with low-back pain. *Journal of Psychosomatic Research*, *27,* 273–281.

Oostdam, E. M. M., Duivenvoorden, H. J., & Pondaag, W. (1981). Predictive value of some psychological tests on the outcome of surgical intervention in low-back pain patients. *Journal of Psychosomatic Research*, *25,* 227–235.

Pheasant, H. C., Gilbert, D., Goldfard, J., & Herron, L. (1979). The MMPI as a predictor of outcome in low-back surgery. *Spine*, *4,* 78–84.

Riley, J. L., III, Robinson, M. E., Geisser, M. E., & Wittmer, V. T. (1993). Multivariate cluster analysis of the MMPI-2 in chronic low-back pain patients. *The Clinical Journal of Pain*, *9,* 248–252.

Riley, J. L., III, Robinson, M. E., Geisser, M. E., Wittmer, V. T., & Smith, A. G. (1995). Relationship between MMPI-2 cluster profiles and surgical outcome in low-back pain patients. *Journal of Spinal Disorders*, *8,* 213–219.

Roland, M., & Morris, R. (1983a). A study of the natural history of back pain Part I: Development of a reliable and sensitive measure of disability in low-back pain. *Spine*, *8,* 141–144.

Roland, M., & Morris, R. (1983b). A study of the natural history of back pain Part II: Development of guidelines for trials of treatment in primary care. *Spine*, *8,* 145–150.

Sanders, S. H. (1995). Minnesota Multiphasic Personality Inventory and clinical pain: The baby or the bathwater? *Pain Forum*, *4,* 108–109.

Spengler, D. M., Freeman, C., Westbrook, R., & Miller, J. W. (1980). low-back pain following multiple lumbar spine procedures: Failure of initial selection. *Spine*, *5,* 356–360.

Stauffer, R., & Coventry, M. B. (1972). Anterior interbody lumbar spine fusion. *The Journal of Bone and Joint Surgery*, *54,* 756–768.

Strassberg, D. S. (1991). Interpretive dilemmas created by the Minnesota Multiphasic Personality Inventory 2 (MMPI-2). *Journal of Psychopathology and Behavioral Assessment*, *13,* 53–92.

Strassberg, D. S., Tilley, D., Bristone, S., & Oei, T. P. S. (1992). The MMPI and chronic pain: A cross-cultural view. *Psychological Assessment*, *4,* 493–497.

Taylor, V. M., Deyo, R. A., Cherkin, D. C., & Kreuter, W. (1994). Low-back pain hospitalization: Recent United States trends and regional variations. *Spine*, *19,* 1207–1212.

Turk, D. C., & Fernandez, E. (1995). Personality assessment and the Minnesota Multiphasic Personality Inventory in chronic pain: Underdeveloped and overexposed. *Pain Forum*, *4,* 104–107.

Turner, J. A., Ersek, M., Herron, L., Haselkorn, J., Kent, D., Ciol, M. A, et al. (1992). Patient outcomes after lumbar spinal fusions. *JAMA*, *268,* 907–911.

Turner, J. A., Heron, L., & Weiner, P. (1986). Utilility of the MMPI Pain Assessment Index in predicting outcome after lumbar surgery. *Journal of Clinical Psychology*, *42,* 764–769.

Turner, R. S., & Leiding, W. C. (1985). Correlation of the MMPI with lumbrosacral spine fusion results: Prospective study. *Spine*, *10,* 932–936.

Trief, P. M., Grant, W., & Fredrickson, B. (2000). A prospective study of psychological predictors of lumbar surgery outcome. *Spine*, *25,* 2616–2621.

Uomoto, J. M., Turner, J. A., & Herron, L. D. (1988). Use of the MMPI and MCMI in predicting outcome of lumbar laminectomy. *Journal of Clinical Psychology*, *44,* 191–197.

Volinn, E., Mayer, J., Diehr, P., Van Koevering, D., Connell, F. A., & Loeser, J. D. (1992). Small area analysis of surgery for low-back pain. *Spine*, *17,* 575–581.

Waddell, G. (1987). A new clinical model for the treatment of low-back pain. *Spine*, *12,* 632–644.

Watkins, R. G., O'Brien, J. P., Draugelis, R., & Jones, D. (1986). Comparisons of preoperative and postoperative MMPI data in chronic back patients. *Spine*, *11,* 385–390.

Weisberg, J. N., & Keefe, F. J. (1999). Personality, individual differences, and psychopathology in chronic pain. In R. J. Gatchel & D. C. Turk (Eds.), *Psychosocial factors in pain: Critical perspectives* (pp. 56–73). New York: Guilford.