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Prediction of the prognosis of somatoform disorders using the Minnesota Multiphasic Personality Inventory (MMPI)

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ABSTRACT

Objective: To elucidate the possibility of using the Minnesota Multifaceted Personality Inventory (MMPI) to predict the prognosis of somatoform disorders, which are often treatment-resistant, we investigated the prognosis of somatoform disorders predicted using the MMPI.

Methods: During the period from January 1, 2013, to December 31, 2017, 125 cases of somatoform disorder were diagnosed in the psychiatric department of Fukushima Medical University Hospital, among which, 67 were consultation-liaison psychiatry cases and 58 cases were only psychiatric cases. Clinical information, MMPI scores, and prognosis information were collected from medical records in each case, and then statistical analysis was performed.

Results: The results showed that the unchanged group had significantly higher scores than the improved group on only the Hy scale. Receiver operating characteristic analysis of the Hy scale scores of the improved and unchanged group was then conducted to calculated a cutoff value. The cutoff point was 73.5 with a sensitivity of 0.557 and a specificity of 0.717.

Conclusion: For patients diagnosed with somatoform disorder who had an MMPI Hy scale score higher than the cutoff value, improvement with conventional supportive

psychotherapy or drug therapy was predicted to be difficult. Therefore, the cutoff point identified in this study appears to be an important index for selecting treatment for somatoform disorders.

Keywords:

Hy score

consultation-liaison psychiatry

Minnesota Multifaceted Personality Inventory (MMPI)

Prognostic predictor

Somatoform disorders

Treatment-resistant

1. Introduction

Somatoform disorders are included in the traditional clinical classification of neuroses and are also classified as neurotic disorders according to the 10th revision of the International Classification of Diseases (ICD-10) [1] and the Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision (DSM-IV-TR) [2,3]. Chronic pain is classified into nociceptive pain, neuropathic pain, and psychogenic pain [4]. Among these types, psychogenic pain is classified as persistent somatoform pain disorder among the somatoform disorders in the ICD-10, and as chronic pain disorder in the DSM-IV-TR [5]. In addition to the distress of experiencing the symptoms themselves, chronic pain is likely to cause secondary disorders such as psychiatric problems and a decreased ability to carry out activities of daily living. Therefore, chronic pain is a serious disorder that cannot be overlooked, especially economically, as it can lead to labor loss in the productive population and increased medical expenses because of repeated medical examinations and long-term treatment [6].

As pharmacotherapy, selective serotonin reuptake inhibitors (SSRIs),antipsychotic drugs, and benzodiazepine anxiolytics have been considerd to be useful to some extent for somatoform disorders[7]. However, although research elucidating the neural basis of somatoform disorders is currently in progress, no effective treatment has been

established. Therefore, recovery from somatoform disorders is often difficult and largely dependent on psychosocial treatment [8].

Since 1996, consultation-liaison psychiatry services, which consist of medical teams including orthopedists, psychiatrists, and other co-medical staffs such as nurses, physical therapists, clinical psychologists, clinical pharmacists, and social workers, have been conducted in Fukushima Medical University Hospital(FMUH). These conferences are held once a month and involve discussions on how to deal with the psychosomatic problems of patients diagnosed with somatoform disorder. Owing to these conferences, we have accumulated substantial MMPI data for these cases. It has been considered that many patients who have psychosocial personality problems or psychiatric disorders have previously consulted an orthopedist because of chronic pain and numbness or have not been satisfied with conventional orthopedic treatment [5,9]. The multidisciplinary nature of this conference is based on recognition that “team medical care,” in which related medical staffs cooperate and provide patient-centered medical care, is essential to promote effective treatment and solve various problems. This liaison psychiatry approach is characterized by a basic policy of the orthopedist remaining involved in treatment because even if the patient has psychiatric, psychological, or social problems, the chief complaint is a physical symptom [5,9].

Numerous studies have reported personality tendencies in patients with somatoform disorders based on the MMPI [10–18]. However, to our knowledge, no studies have assessed the utility of the MMPI as an prognostic predictor of somatoform disorders, and only a few reports have used it to predict outcomes of surgical treatment for chronic back pain [19–22]. In FMUH, the MMPI has been continuously conducted, and data have been accumulated on the cases discussed in the liaison conferences for the purpose of evaluating whether patients with chronic pain suffer from latent paranoia, depression, or other psychiatric disorders, as well as whether their personality may affect their symptoms [23,24].

Although the MMPI has mainly been used for diagnosis and assessment, if it could be used for the prediction of prognosis of somatoform disorders, treatment would be expected to proceed more smoothly because more effective interventions could be started at an early stage, and the patient could recognize the therapeutic effects sooner. In addition, considering that MMPI takes quite much time to be completed due to a large number of question items, over 500, if key items predicting negative outcome could be identified, it should be more useful and reduce psychological burden of target patients.

The present study has two purposes; one is to clarify psychological and biological

factors associating with negative outcome of somatoform disorders, another is to identify key items of MMPI predicting negative outcome. Therefore, we collected the data from patients who all had received MMPI in clinical settings, classified them into two groups (improvedgroup vs. unchanged group) based on the chart review, and examined two groups.

2. Methods

2.1. Design and study population

During the period from January 1, 2013, to December 31, 2017, 125 cases of somatoform disorder were diagnosed at the psychiatric department of Fukushima Medical University Hospital based on the ICD-10 [1]. Among these cases, 67 were associated with the consultation-liaison psychiatry approach, and 58 with only the psychiatric approach. Also among these cases, 80 were classified as Persistent somatoform pain disorder, 31 were as Somatization disorder, 8 were as Undifferentiated somatoform disorder, 4 were as Somatoform autonomic dysfunction, and 2 were as Other somatoform disorders. All these cases were treated conventional supportive psychotherapy or pharmacotherapy.

2.2. Measurements and procedures

The Minnesota Multifaceted Personality Inventory (MMPI) is a standardized psychometric test of adult personality and psychopathology based on the questionnaire method developed by Hathaway and McKinley of the University of Minnesota in the late 1930s [25,26]. The MMPI is composed of 550 items, and hundreds of additional scales have been developed. In the United States, a re-standardization of the MMPI began around the end of the 1980s because of problems with the wording of the item text and inadequate standardization procedures in the original version. The second version, the MMPI-2, maintained continuity with the original. The Japanese version of the MMPI was published in 1963, but mistranslations and problems with standardization procedures were apparent from the beginning, and efforts to resolve these problems began around 1990. The New Japan Version of the MMPI was published in 1993, and is still currently used in Japan [25,26]. The original purpose of the MMPI was to provide objective information necessary for psychiatric diagnosis. Subsequently, the purpose shifted to personality assessment, and thus, it is now one of the most frequently used personality tests around the world [25,26]. Actually, more than 12,000 papers have been published on the MMPI and MMPI-2 since the late 1940s [27].

From medical records from May 1, 2019 to July 31, 2019, we collected

information on factors that may affect the prognosis of somatoform disorders for each case, including age, gender, duration of illness, the comorbidity of developmental disorders, decreased cerebral blood flow, history of surgery, MMPI profile, and presence of the conversion V pattern on the MMPI. Then, we identified patients indicating negative outcome based on the following information obtained from the charts : (1) Subjective estimation regarding pain, (2) Social function including ADL. This group was named “improved group (IG)” and others named “non-improved group (NIG)”.

We profiled four validity scales (?, L, F, K; Table 1) and 10 clinical scales (Hs, D, Hy, Pd, Mf, Pa, Pt, Sc, Ma, Si; Table 2) as basic scales for the MMPI [9,28]. The interpretation of the conversion V pattern is shown in Table 3. Decreased cerebral blood flow was defined as when a radiologist reported that “there was low blood flow(Vd less than 30ml/ml by ARG method)” based on N-isopropyl-(^{123}I)*p*-iodoamphetamine computed tomography, regardless of the brain region. The comorbidity of developmental disorders was defined as when a psychiatrist noted autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), or pervasive developmental disorder in a patient’s medical records. A history of surgery was defined as any descriptions of orthopedic surgery in a patient’s medical records. This study was approved by the Ethics Committee of Fukushima Medical University (approval No.

2941).

2.3. Statistical analysis

We descriptively compared each factor between the IG and NIG groups. Differences between groups were analyzed using the Mann–Whitney U test, the Student *t*-test, and the chi-squared test. Among the MMPI scales, receiver operating characteristic (ROC) curves that showed a significant difference between the IG and NIG were created for the Hy scale. The area under the curve (AUC) and 95% confidence intervals (CIs) were calculated, as was the cutoff value using Youden's index. Statistical analysis was performed using SPSS ver. 26 (SPSS, Chicago, IL, USA), and p values < 0.05 were considered statistically significant.

3. Results

In total, 125 patients (49 males, 76 females; mean age ± standard deviation [SD], 51.9 ± 17.4 years) participated in this study.

3.1. Prognosticcomparison of the participants' basic characteristics (Table 4)

No significant differences in age, gender, duration of illness, the comorbidity of

developmental disorders, decreased cerebral blood flow, or history of surgery were observed between the IGand NIG. The mean age ± SD of the IG and NIG were 49.3 ± 17.8 and 53.8 ± 17.5, respectively ($p = 0.167$). Regarding the gender ratio, 16 (34.6%) males and 30 females (65.2%) were in the improved group, and 33 males (41.8%) and 46 (58.2%) females were in the unchanged group ($p = 0.44$). The median duration of illness in the IG was 35 months (25th–75th percentile = 24–91), and that in the NIG was 54 months (25th–75th percentile = 24–120; $p = 0.168$). The numbers of patients with decreased cerebral blood flow were 14 (51.9%) in the IG and 30 (57.7%) in the NIG ($p = 0.62$). The numbers of patients who had a history of surgery were 15 (32.6%) in the IG and 26 (32.9%) in the NIG ($p = 0.972$).

No significant differences were found in the presence of the conversion V pattern between the IG and NIG (17.4% vs. 17.7%, respectively; $p = 0.963$). Regarding the presence of developmental disorders, the comorbidity rate of developmental disorders was 10.9% in the IG and 25.3% in the NIG; this rate tended to be higher in the unchanged than in the improved group, but this difference was not significant ($p = 0.051$).

3.2. Prognostic comparison of each MMPI scale (Table 5)

Regarding the results of the Student *t*-test for each scale of the MMPI, the NIG group showed a significantly higher value than the IG on the Hy scale (IG, 66.2 ± 15.4 vs. NIG, 73.5 ± 12.4; $p = 0.04$). The scores on the ? scale were 45.4 ± 11.1 for the IG and 49.0 ± 9.3 for the NIG; although the IG tended to have lower scores, this difference was not significant ($p = 0.051$).

3.3. ROC curves of the Hy score for all participants (Figure 1)

The results of the ROC analysis performed using the Hy scores of all participants indicated a significant difference between the IG and NIG groups, with an AUC (95% CI) of 0.652 (0.55–0.753). The cutoff point was 73.5 with a sensitivity of 0.557 and a specificity of 0.717.

4. Discussion

The MMPI can identify the personality of subjects from multiple aspects based on answers to questions assessing, for example, hypochondriac, obsessive, and compulsive tendencies. A configuration in which the Hypochondriasis (Hs) and Hysteria (Hy) scale are T = 70 or more and the T score of these two scales is 10 or higher than that of the Depression (D) scale is called the “conversion V” pattern. The conversion V pattern

suggests that subjects tend to “replace” their psychological problems with socially acceptable ones, such as physical complaints. Tendencies to escape from a situation through physical complaints, to try and control others, and to suppress or deny the problem are then presumed [9,10].

Then, We carefully discuss each result in detail as follows.

4.1. Comparison between the improved and unimproved prognosis groups

We selected basic characteristics such as age, gender, duration of illness, the comorbidity of developmental disorders, decreased cerebral blood flow, history of surgery, and the conversion V pattern on the MMPI as factors that may affect the outcomeof somatoform disorders. An analysis of each outcome group did not reveal any significant differences. Regarding the cerebral blood flow, it has been reported to be decreased in patients with chronic pain[29]. But no significant differences were found in this study. But the NIG was more likely to have developmental disorders. It has been reported that among developmental disorders in children, both ASD and ADHD are associated with a high rate of chronic pain [30,31]. For ASD and ADHD, it is said that a therapeutic effect can be obtained by combining psychosocial treatment in addition to pharmacotherapy [32,33]. Therefore, when the comorbidity of developmental disorders

is recognized, it is thought that somatoform disorders could be improved by performing a therapeutic intervention particularly for developmental disorders. In addition, analysis of each scale of the MMPI showed that only the Hy scale had a significant difference, indicating that the NIG had higher scores on the Hy scale than the improved group. We discuss about what this result mean in detail as follows.

4.2. Significance of high scores on the Hy scale

A high score on the Hy scale indicates a tendency to avoid responsibilities related to psychological conflicts by converting these to physical symptoms (a tendency to use conversion symptoms). It also means that individuals with a high Hy score tend to be immature and lack self-insight, indicating that their relationships with other people are often superficial, even though they may appear to be appear to be socially well adopted [9]. A significant difference was observed between the IGand NIG only in this Hy scale score. Therefore, ROC analysis was performed on the Hy score for the IG and NIG, resulting in a cutoff score of 73.5. Previous studies have reported that patients with chronic pain show higher Hy scores [34,35]. On the other hand, when scores on the K and Hs scales are low, only a high Hy scale score is considered insufficient to consider whether the pain is psychogenic [36,37].

However, even if only a high Hy scale score is insufficient to determine whether

the pain is psychogenic, a high Hy score is still considered to indicate a remarkably severe degree of distress in terms of physical symptoms. In addition, all cases analyzed in this study had already been diagnosed as somatoform disorder. Few reports have been published on the outcome viewpoint of the MMPI for somatoform disorders, and no reported cases have shown meaningful profiles or characteristics for each scale [38].

The cutoff point calculated in this study was 73.5, which was even higher than the score generally considered to be abnormal (70). If the Hy scale score of a patient diagnosed with a somatoform disorder is higher than this cutoff value, he or she is considered difficult to treat with conventional supportive psychotherapy or pharmacotherapy. In such cases, it may be necessary to consider psychiatric "multidisciplinary" treatment, which is a further enhancement of conventional treatments [39–43], e.g., psychosocial treatment such as cognitive behavioral therapy [44–48] or mindfulness therapy [49], pharmacotherapy, and environmental adjustments. Therefore, this cutoff point appears to be an important index for treatment selection in patients with somatoform disorder. However, since this was a retrospective study, if the Hy scale score exceeds the cutoff point, prospective studies are needed to compare the prognoses of the following two groups: one that is provided with therapeutic interventions such as augmented pharmacotherapy and psychotherapy, psychosocial

treatment, and environmental adjustments, and another that receives standard therapy (general pharmacotherapy and supportive psychotherapy).

4.3. Limitations

The classification of the outcome of somatoform disorder among the current group used in this study was based on only the chart review not more reliable ways such as diagnostic (structured) interviews or self-administered questionnaires.

4.5. Conclusions

In this study, we performed a basic examination regarding the possibility of predicting the prognosis of patients with somatoform disorders based on the MMPI. The results suggested that the Hy scale score might influence the prognosis. The cases exceeding the cutoff point based on ROC analysis are considered difficult to treat with conventional supportive psychotherapy or pharmacotherapy. Therefore, this cutoff point could be an important index in considering treatment options for improving the prognosis of patients with somatoform disorders.

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Declaration of Competing Interests

The authors have no competing interests to report.

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Figure legend

Fig. 1. Receiver operating characteristic (ROC) curves of the Hysteria (Hy) scale score on the Minnesota Multiphasic Personality Inventory (MMPI) for all participants. ROC analysis was performed using the Hy scale scores for all participants that showed a significant difference between the improved and unchanged groups; the area under the curve (AUC) (95% confidence interval) was 0.652 (0.55–0.753), as calculated using Youden's index, with a cutoff value of 73.5.

Table 1

Interpretation of the validity scales.

Scale and abbreviation	Scale name	Interpretation of score
?	Cannot say	A tally of omitted items. High scores may be due to obsessiveness, defensiveness, difficulty in reading, confusion, hostility, or paranoia. More than 10 left unanswered may be of clinical significance. Twenty or more left unanswered should be considered significant.
L	Lie	Tendency to create a favorable impression as a response bias, conventional, rigid, moralistic, repression, denial, and insightlessness. A high L can mean anything from a very well-mannered normal wanting to give a good impression, to a compensated paranoid. A high L will submerge scales of obvious psychopathology and inflate scales of healthy functioning such as the Ego Strength scale. Low: (< Raw 3). Admitting to minor faults and shortcomings, independent, self-reliant.
F	Infrequency	Very high (> T99) possible random, exaggerated, or mis-scored profile. Very high scores (T > 90) commonly found with psychotic patients. High scores (> T70), best measure of overall psychopathology, resentment, acting out, moodiness. Mostly elevations in the F scale are due to psychopathology; high item overlap with scale 8. Low scores (T < 45), possible fake good profile.
K	Defensiveness	If there are signs of psychopathology in the history, then high K indicates defensiveness, insightlessness, intolerance, dogmatism, and being controlling. Very high scores are usually a sign of defensiveness. High scores are common in individuals who are well

	adjusted and well educated, and tend to be in control of their lives. Low (< T46). Guarded prognosis for any insight therapy since their ego strength is low; masochistic confessors, poor self-concept, distrustful, and angry. A very low K could often be the only indication of psychopathology in an MMPI profile.

MMPI, Minnesota Multiphasic Personality Inventory.

Table 2

Interpretation of the clinical scales.

Scale and abbreviation	Scale name	Interpretation of an elevated score
Hs	Hypochondriasis	Excessive preoccupation with the body and physical symptoms
D	Depression	Sadness, discomfort, and dissatisfaction with life
Hy	Hysteria	Feeling overwhelmed by stress
Pd	Psychopathic deviance	Rebellion, difficulty adhering to standards of society
Mf	Masculinity-femininity	Lack of stereotypic masculine interests (in men; high scores are rare among women)
Pa	Paranoia	Excessive sensitivity, hostility, and suspiciousness (very high scores indicate psychotic behavior)
Pt	Psychasthenia	Anxiety, tension, worry, and obsessive-compulsive disorder tend to score high
Sc	Schizophrenia	Confusion, disorganization, unusual thought processes
Ma	Hypomania	High energy and agitation, overactivity, unrealistic self-appraisal, and mania
Si	Social introversion	Shy, insecure, timid, and introverted

Table 3

Interpretation of conversion V.

Condition	Description
The Hs and Hy scales are T = 70 or more, and are T = 10 or more higher than the D scale.	This suggests that patients tend to "replace" their psychological problems with socially acceptable ones, such as physical complaints, including a tendency to escape from situations set by physical complaints or to control others. It is presumed that the problem is suppressed or denied.

Table 4

Basic characteristics of all participants (comparison by prognosis).

	Improved n = 46	Un-improved n = 79	*p*
Age (years)	49.3 ± 17.8	53.8 ± 17.5	0.167
Gender			
Male	16 (34.8)	33 (41.8)	0.440
Female	30 (65.2)	46 (58.2)	
Duration of illness (months)	35 (24–91)	54 (24–120)	0.168
Comorbidity of developmental disorders			
Yes	5 (10.9)	20 (25.3)	0.051
No	41 (89.1)	59(74.7)	
Decreased cerebral blood flow			
Yes	14 (51.9)	30 (57.7)	0.620
No	13 (48.1)	22 (42.3)	
Conversion V			
Yes	8 (17.4)	14 (17.7)	0.963
No	38 (82.6)	65 (82.3)	
History of surgery			
Yes	15 (32.6)	26 (32.9)	0.972
No	31 (67.4)	53 (67.1)	
Treatment approach			
Liaison psychiatry	23 (34.3)	44 (65.7)	0.538
Only psychiatric	23 (39.7)	35 (60.3)	

Values are expressed as mean ± standard deviation, median (25th–75th percentile), n (%).

Data for decreased cerebral blood flow were missing for 46 cases.

No significant differences were found between the improved and un-improved groups in age, gender, duration of illness, the comorbidity of developmental disorders, decreased cerebral blood flow, history of surgery, or the conversion V pattern. Regarding the presence of developmental disorders, the comorbidity rates of developmental disorders were 10.9% in the improved group and 25.3% in the un-improved group. Although this difference was not significant, the rate in the un-improved group tended to be higher than that in the improved group ($p = 0.051$).

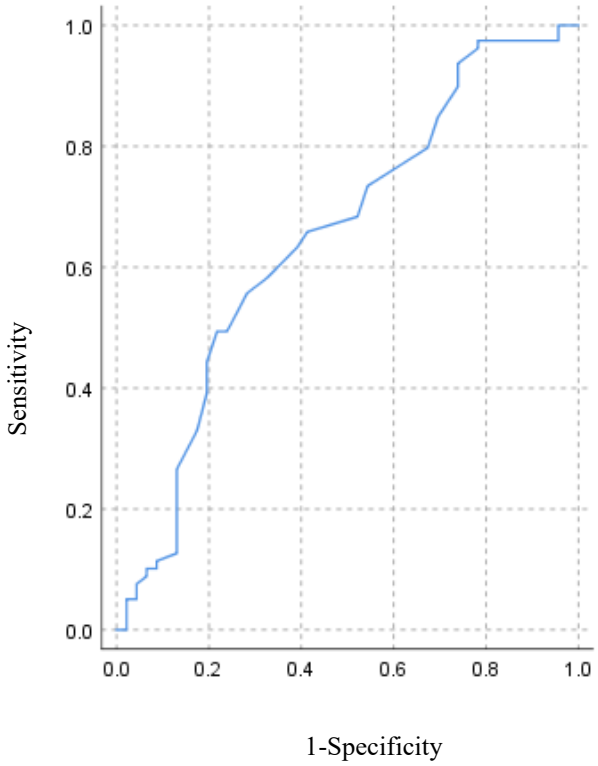
Table 5

Prognostic comparison in each MMPI scale.

	Improved (n = 46)	Un-improved (n = 79)	*p*
?	45.4 ± 11.1	49.0 ± 9.3	0.051
L	54.1 ± 13.2	55.2 ± 11.4	0.615
F	55.8 ± 17.8	59.2 ± 17.8	0.308
K	51.2 ± 11.5	53.8 ± 12.4	0.235
Hs	58.6 ± 19.6	63.8 ± 18.0	0.137
D	66.1 ± 14.8	70.9 ± 16.6	0.105
Hy	66.2 ± 15.4	73.5 ± 12.4	0.004*
Pd	53.8 ± 15.3	55.1 ± 15.3	0.661
Mf	49.5 ± 11.8	49.1 ± 12.6	0.859
Pa	55.9 ± 15.8	60.9 ± 15.5	0.087
Pt	47.9 ± 22.3	47.2 ± 25.8	0.875
Sc	47.9 ± 23.4	50.8 ± 26.0	0.528
Ma	46.7 ± 14.6	46.0 ± 11.5	0.769
Si	54.2 ± 13.3	52.7 ± 12.3	0.525

As a result of a Student *t*-test for each scale of the MMPI, the un-improved group showed a significantly higher value than the improved group on the Hy scale (improved group, 66.2 ± 15.4 vs. un-improved group, 73.5 ± 12.4; p = 0.04). The ? scale scores were 45.4 ± 11.1 in the improved group and 49.0 ± 9.3 in the un-improved group, which were not significant, but the improved group tended to have lower scores (*p* = 0.051).

Figure.1



AUC (95% confidence interval)	*p*	Cutoff value
0.652 (0.55–0.753)	0.004	73.5